

# KENTUCKY

## GEOLOGICAL SURVEY

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PART ONE

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J. B. HOEING, State Geologist

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FRANKFORT, KY.

1914

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## TABLE OF CONTENTS

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	Page
Geology of the Dawson Springs Quadrangle.....	7
Geology of the Earlington Quadrangle.....	69
Economic Geology of a Portion of Edmonson and Grayson Counties .....	155
Analyses of Coals in the Western Coalfield.....	219

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**REPORT ON THE GEOLOGY AND MINERAL  
RESOURCES OF THE DAWSON SPRINGS  
QUADRANGLE.**

**BY**

**A. F. CRIDER**

**1914**

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## LETTER OF SUBMITTAL.

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MR. J. B. HOEING,  
State Geologist.

Dear Sir:

I submit, herewith, a report on the Geology and Mineral Resources of the Dawson Springs Quadrangle. The report is accompanied by a geological map showing the location of faults, the outcrop lines of Nos. 9 and 11 coals, and delineating the boundary line between the Mississippian and the Pennsylvanian rocks. The report is the result of detailed work of the latter portion of the field season of 1913.

The writer desires to acknowledge the assistance rendered by the various coal companies of the region in working out the geology and complicated faulting in the northern part of the quadrangle.

Respectfully submitted,

A. F. CRIDER,

Assistant Geologist.

Frankfort, Ky.,

March 12, 1914.

## TABLE OF CONTENTS.

	Page
Introduction .....	13
Location and area .....	14
Culture .....	14
Topography .....	15
Drainage .....	17
General geology .....	18
Mississippian .....	19
Pennsylvanian .....	22
Sub-conglomerate coal .....	25
Empire coal .....	26
Dawson Springs coal .....	27
Rocks between Dawson Springs coal and No. 9 coal.....	30
Coal 8-b .....	34
No. 9 coal .....	36
Rocks above No. 9 coal .....	47
No. 11 coal .....	48
No. 12 coal .....	51
Structure .....	51
Faults .....	52
Mineral resources .....	60
Coal .....	60
Shales .....	62
Sandstones .....	62
Limestones .....	62
Oil and gas .....	63
Water .....	63
Analyses of mineral waters .....	64

## GEOLOGY AND MINERAL RESOURCES OF THE DAWSON SPRINGS QUADRANGLE.

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### INTRODUCTION.

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The following report is the result of a detailed study of the geology of the Dawson Springs quadrangle in so far as it relates to that portion of the quadrangle which is comprised within the area occupied by Pennsylvanian rocks. Since coal is the principal mineral asset of the region, information relating to the area underlain by workable coals, their quality and accessibility are given in detail. The outcrop lines of No. 9 and No. 11, the two most dependable and most sought-after coals of Western Kentucky, are given on a geological map accompanying this report. The former where present, outcrops sufficiently low in the ridges to give it a secure top and good workable area, whereas the latter occurs so near the crests of much of the territory, where present, as to greatly diminish its value as a workable coal.

One or two coals below No. 9 attain thicknesses, in this quadrangle, of commercial coals and are being mined.

In the northern and south central parts of the quadrangle the rocks are greatly disturbed by a series of approximately east-west block faults which are shown on the accompanying map. Where the fault is visible in the rocks by slicken-sides, breccia, or by the upturned edges of the broken strata, the fault is shown on the map as a solid black line. In regions where the fault is covered or there is some doubt as to its extension, it is shown as a broken line.

## LOCATION AND AREA.

The Dawson Springs quadrangle is, as the name suggests, an area in the shape of a quadrangle embracing 238 square miles, the name of the quadrangle being that of the principal town within the area. It embraces the southwestern portion of Hopkins, the northwestern portion of Christian and a portion of eastern Caldwell counties.

The quadrangle is the unit adopted by the United States Geological Survey, which co-operates with the Kentucky Geological Survey, for making a detailed map of the State. Each unit or quadrangle is 15 minutes of longitude and latitude, or approximately 14 miles from east to west by 17 miles from north to south.

## CULTURE.

Farming is the chief pursuit of the people, but in some parts of the quadrangle the country is so broken that it is very sparsely settled. The bottom lands of the entire area, where well drained, are very fertile. The most suitable upland for farming is in the southeastern and southwestern parts of the region. The soils resulting from the decomposition of the upper Chester and the Pennsylvanian, or coal-bearing rocks, contain an abundant supply of plant food for corn, tobacco, grains, grasses and fruits, but the topography is generally so rough that the soil, unless properly fostered, is carried away by erosion. Most of the land, when first cleared, produces abundant crops, but the poor system of crop rotation, or rather the lack of it, allows the soil to waste away, and, under the present system of farming, by the time the stumps and roots are entirely eliminated the land becomes worthless. More rye and other winter crops should be grown on land that is now lying fallow or bare through the winter seasons. Sandy loam soils, and especially those on the slopes, should be kept in red top grass the greater part of the time. It is claimed that the sandy loam soils of northern Christian County produce a finer quality of dark tobacco than the more clayey, limestone soil of the southern part of the county.

In the northern part of the region coal mining furnishes labor for a large number of people. There are four large commercial mines, and a number of country banks which supply the local trade. Most of the mines are located in the northern third of the quadrangle. The only other district which supplies any coal is in northern Christian County, near the eastern edge of the quadrangle, and two or three small mines near Franklin's store, about 2 miles south of the center of the quadrangle.

The main line of the Illinois Central railroad crosses the area in a northeast southwest direction and furnishes the principal means of transportation by rail. It forms the outlet, by short spurs, of the coal from mines of the northern district. The Evansville branch of the Louisville & Nashville Railroad parallels the eastern edge of the quadrangle and is nowhere more than 2 miles from it, but does not enter the quadrangle, except by a short spur, built from Empire to a coal mine located at the eastern border of the quadrangle, south of the center.

Tradewater River was formerly navigable for small craft during a portion of the year as far as Dawson Springs, but the channel has become so clogged with tree tops and logs that it is no longer navigable.

Dawson Springs, a town of about 2,000 inhabitants, is the most important trading center of the area under discussion. Within the past five or six years it has been a much frequented health resort on account of a large number of mineral waters found there. The town draws its chief recruits from the malarial districts bordering the Mississippi River from Cairo, Illinois, to the Gulf Coast.

St. Charles, Crabtree, Carbondale and Daniel Boone are small mining places, on or near the Illinois Central Railroad east of Dawson Springs.

## TOPOGRAPHY.

The surface of the Dawson Springs quadrangle was originally a plane which has been greatly dissected by stream erosion. It is highest in the south and slopes gently to the northwest. The maximum elevation is along the watershed between Tradewater and Cumberland rivers, in the southwestern portion of the quadrangle,

between Woods Chapel and Hawkins where the elevation is slightly more than 780 feet above sea level. In the northwestern part of the area, on the ridge between the waters of Tradewater and Lick Creek, the elevation is 580 feet above sea level. In the eastern part of the area, between the waters of Tradewater and Green rivers, the crest of the divide rises to a maximum elevation of 700 feet in the north, dropping to a more general elevation, in the central part, of about 600 feet.

In the southern third of the area the water sheds are flat topped ridges which are from  $\frac{1}{4}$  to 1 mile wide on top. In the central and northern two-thirds of the quadrangle the ridges between the streams are narrow and in many instances they have been dissected by stream erosion until they are a succession of rounded peaks and saddles. The best proof of this is the fact that in the southern portion the main thoroughfares, as far as possible, follow the crests of the ridges, whereas in the central and northern parts they generally cross ridges and valleys alike.

The entire region is one of rugged hills with steep slopes and narrow valleys. The amount of relief or dissection of the streams varies locally from 150 to 300 feet, whereas the difference between the highest and the lowest points of the quadrangle is 400 feet.

The area of the most rugged hills is a belt of country 5 to 7 miles wide lying just southwest of Tradewater River. In general it may be said to correspond to the area of outcrop of the basal member of the Pennsylvanian rocks, generally known as the "Conglomerate." The streams flowing across this region have cut deep narrow valleys with steep sandstone cliffs on either side.

In the extreme southwestern part of the quadrangle is a small area of more level land which owes its origin to the underlying limestone and shales which are not so much disturbed and broken and less exposed to the action of the weathering agents than the sandstones to the northeast.

Another area of less rugged topography occurs as a narrow east and west belt lying just north of Cany Creek. It is in a down-faulted block which is largely underlain by shales.

## DRAINAGE.

Tradewater River forms the principal drainage basin of the area. It enters the quadrangle one mile west of the southeast corner of the sheet, flows in a general northwest direction, and leaves the quadrangle  $2\frac{1}{2}$  miles south of the northwest corner. It drains the entire area except about 19 square miles in the southwestern part, which is drained by tributaries of Cumberland River, and a narrow strip 2 miles wide and 9 miles long along the eastern border, which is drained by branches of Pond River.

From the headwaters to the mouth of Whitethorn Creek, Tradewater River flows through a narrow valley deeply cut into the hard sandstone of the upper Chester. From the mouth of Whitethorn to Collins Bridge the valley bottom widens to about five times its width on the upper waters. From Collins Bridge to the mouth of Buffalo Creek the river is again confined in a deep canyon-like gorge with even a narrower valley bottom than is found in any other part of its course in this quadrangle. From the mouth of Buffalo Creek to where it leaves the Dawson Springs sheet the river has meandered back and forth across a flood plain which in places is more than a mile in width.

The peculiar widening and narrowing of the flood plain of Tradewater—and it is likewise true of the smaller streams though not to such a marked degree—is due to the nature and structure of the rocks through which the stream is cutting. In hard sandstone, like that from Collins Bridge to the mouth of Buffalo Creek, the entire force of the stream is spent in aggrading the bottom, and the sides of the valley recede very slowly. Where the stream flows through a region underlain by shales with sandstone in the lower courses, as is true in a number of places along Tradewater River, the aggrading action of the stream along the region underlain by shales is retarded to keep pace with that of the sandstone stretches below, and its aggrading power is converted into a degrading force which acts on the sides of the valleys. Side streams develop more rapidly and the slopes in the shaly region are more gentle than in the hard sandstone or limestone region.

There is some evidence of the pounding of the waters of Tradewater between Collins Bridge and the mouth of Sandlick Creek, due to a slight uplift near the center of the quadrangle. This may have influenced the widening of the valley above Collins Bridge. Further evidence of the pounding of the waters is the abandonment of the original channel of Castleberry Creek, which formerly emptied into Tradewater a few feet below and on the opposite side of the mouth of Sandlick Creek. However, this abandonment of its original channel could have been the result of piracy on the part of a small stream which occupied the position of the lower waters of Castleberry Creek.

There is a marked difference in the nature of the streams entering Tradewater on the southwest from those entering it on the northeast. On the southwest side there are six large parallel streams all flowing to the north with the general dip of the rocks. There is a lack of the dentritic structure of the drainage lines and the drainage basins of some of the streams are nearly as broad at their mouths as at their heads.

Northeast of the river the central part of the area is drained by Buffalo and Cany creeks. Castleberry and some smaller branches drain the southeastern part, and Lick and Richland creeks the extreme northern part. Pleasant Run, Crab Orchard and Drake creeks, with their small tributaries, flow east to Pond River. The dissection of the country north and east of the river is more complete than south and west of it, and the streams show a more decided dentritic or branching structure.

The fall in Tradewater River from a point  $\frac{1}{2}$  mile north of where it enters the Dawson Springs quadrangle to level of the water below the old mill dam at Dawson Springs is 100 feet. The total fall from where it enters to where it leaves the quadrangle is about 110 feet.

#### GENERAL GEOLOGY.

Dawson Springs quadrangle lies wholly within the area of sedimentary rocks, consisting of sandstones, shales, limestones and coals, the predominating material coming in the order named. The presence of igneous rocks has never been discovered although the southern

part of the quadrangle is greatly faulted, similar to parts of Crittenden County where igneous rocks do occur.

The oldest rocks outcropping in the Dawson Springs quadrangle are of Mississippian age. They form the surface of nearly the southern third of the quadrangle. They are sandstones, shales and limestones. Resting unconformably on the Mississippian are the Pennsylvanian rocks which form the bed rock of the entire quadrangle north of the outcrop line of the Mississippian. All of the commercial coals of this and other parts of Western Kentucky occur in the Pennsylvanian series. The disintegrated materials of the Mississippian and the Pennsylvanian rocks form the surface soils and stream alluvium.

#### MISSISSIPPIAN.

The area of outcrop of the Mississippian rocks is shown on the map as the uncolored portion. These rocks are brought to the surface by the continued southward and westward rise from the center of the great basin of Western Kentucky in which the Western Kentucky coals occur. On account of this rise, augmented by two series of down-thrown block faults crossing the quadrangle, one in the northern and the other in the southern parts, the Mississippian rocks are brought to the surface much farther north than they would have been without the influence of the dip and the faults.

The rocks of Mississippian age are a series of sandstones, shales and limestones. The sandstones are generally harder and finer grain than the sandstones of the Pennsylvanian. The uppermost sandstone of this series forms the surface of a large part of the southern third of the quadrangle. It is of a fine grained massive character and white to gray in color. Where the streams have carved the deep valleys in this sandstone the slopes are often perpendicular or very steep, forming a type of topography similar to that of the basal member of the Pennsylvanian. The lower sandstones are thinner bedded and usually more argillaceous than the upper sandstone.

The shales of Mississippian age are usually distinguished from the Pennsylvanian shales by the greater

percentage of lime in the former. They weather into a tough, red, sticky clay, which forms the worst roads of the district.

Between the sandstone members of the Mississippian are a series of limestones of various thicknesses. They are steel gray to white in color and contain characteristic marine fauna by which the individual beds may be distinguished even where only one appears at the surface.

Sandstones predominate in the upper part of the Mississippian where the limestone and shale members are comparatively thin and argillaceous. The static deep-sea conditions which prevailed when the thick deposits of limestone in the lower and middle parts of the series were formed, gradually became more unstable by an uplift of the sea bottom and a recession of the shore line. The thick deposits of sandstone of the upper Mississippian and the lower Pennsylvanian represent the turning point between the deep-sea conditions in which the thick Mississippian limestones were formed and the slighter relative changes of submergence and emergence in the Pennsylvanian period in which the coals were formed.

By faulting and folding a little more than 800 feet of Mississippian rocks are exposed in the Dawson Springs quadrangle. On the northeast limb of a large fault which enters the Dawson Springs quadrangle from the west,  $1\frac{1}{2}$  miles south of Ruth, the following section is exposed along the upturned edges of the fault. The section was made along the Illinois Central railroad beginning  $\frac{1}{2}$  mile southwest of Claxton.

Section of Mississippian Near Claxton.

	Feet	Inches
1. Limestone interbedded with shale with Conglomerate sandstone close above*	5	
2. Shale	1	
3. Limestone	1	
4. Shale	4	
5. Limestone	0	7
6. Shale	7	
7. Limestone	4	

\*There is everywhere in this region a marked unconformity between the Mississippian and the basal member of the Pennsylvanian, due to greater or less erosion of the upper part of the Mississippian.

	Feet	Inches
8. Shale	7	
9. Limestone	4	
10. Shale	5	
11. Limestone	2	
12. Covered	194	
13. Siliceous shale	5	
14. Thin bedded sandstone	4	
15. Fine grained sandstone	6	
16. Shale	82	
17. Coarse sandstone below changing to thin bedded above	30	
18. Limestone	4	
19. Shale with thin bands of sandstone	50	
20. Massive sandstone	15	
21. Thin bedded quartzose sandstone	15	
22. Soft clay shale	35	
23. Limestone conglomerates containing iron concretions and crinoid stems	1	6
24. Quartzitic sandstone	1	3
25. Very impure ferruginous limestone similar to No. 23	1	6
26. Thin bedded sandstone	7	
27. Fine grained hard sandstone	10	
28. Limestone and chert, about	40	
29. Covered, about	140	
30. Siliceous shale	10	
31. Sandstone	4	
32. Clay shale	15	
33. Sandstone	4	
34. Blue calcareous shale	60	
35. Sandstone	3	
36. Shale	7	
37. Quartzitic sandstone containing irregular beds of shale	20	
38. Blue calcareous shale	15	
Total	819	10

A short distance west of where the above section ends massive beds of white to gray limestone appear at the crest of a sharply folded anticline which farther east is broken into a fault. This is the lowest exposure of the Mississippian rocks in or adjacent to the Dawson Springs quadrangle. What is apparently the same limestone outcrops in the southwestern part of the quadrangle in Caldwell County. These lower limestones do not appear at the surface in that part of Christian County lo-

cated on the Dawson Springs sheet. The limestones which occur on Sandlick Creek and its tributaries and on the other tributaries of Tradewater in the southeastern part of the area are those that come near the top of the Mississippian.

The Mississippian rocks occur along Montgomery and Piny Creeks, in Caldwell County, where they are separated from the main body by an east-west belt of Pennsylvanian which has been brought down below its natural position by a series of faults at right angles to the dip.

At James B. Haile's  $2\frac{1}{2}$  miles south of east of Ruth on Piny Creek, is an outlier of Mississippian limestone, covering an area of about  $\frac{1}{2}$  mile square. It is entirely surrounded by the lower sandstone of the Pennsylvanian. It is brought to the surface by a steeply westward plunging fault which has brought the older rocks to the surface.

A similar outlier occurs just south of Clardy and another one just south of Pod in the eastern half of the quadrangle along the line of the Clardy fault.

#### PENNSYLVANIAN.

The Pennsylvanian rocks form the surface of more than two-thirds of the entire area of the Dawson Springs quadrangle. The southern boundary is a very irregular line, beginning  $\frac{1}{2}$  mile north of Crossroads church, near the western boundary, and following a fault line somewhat south of east to Piny Creek. From here to Concord church the contact between the Pennsylvanian and the Mississippian is an irregular line interrupted by two step-faults, as shown on the accompanying map. From Concord church the line of contact follows approximately the same elevation in a northeast direction to near Clardy where it is again interrupted by a large fault. The fault plane forms the boundary to the east as far as Tradewater River. From there it swings southward for about a mile and then bears eastward at approximately the same elevation, to Adams school house. From there to where it leaves the quadrangle the contact line is again greatly influenced by faulting. The line of contact be-

tween the two series is well exposed in the deep railroad cut 1 mile north of Crofton (just east of this quadrangle) as graphically shown in Figure 1.

That the Pennsylvanian rocks once extended farther south than they now exist is shown by a series of small outliers a short distance south of the main body on the eastern half of the sheet. The most westward outlier is a small one in the region of Concord church. This one has been separated from the main body by a fault assisted by erosion. A much larger one, with a smaller one adjacent to it on the north, occurs between Sandlick Creek and Tradewater River, near the mouth of the former stream. Its southward extension is cut off by an east-west fault. A small outlier occurs 1 mile east of Tradewater just north of Whitethorn Creek.

All of the above mentioned outliers are capped by a coarse massive sandstone containing more or less rounded, white quartz pebbles. This sandstone is known as the "Conglomerate" sandstone and is the lowest member of the Pennsylvanian series. In places it is fairly studded with quartz pebbles, but in a short distance it may contain only a few scattering ones and in other localities it is entirely void of them. In the latter instance it may be confused with the massive sandstone of the upper Chester. The conglomerate, however, is a rougher, coarser grained rock than the Chester sandstone, and contains more ferruginous matter and is more highly cross-bedded. The conglomerate frequently weathers into deep recesses or rounded holes in cliffs and presents a peculiar honeycombed structure not common in the Chester. At the base of the conglomerate is a marked unconformity which does not exist at the base of the massive Chester sandstone. The two sandstones may be distinguished by the fact that a thick deposit of shales overlies the conglomerate and a thinner deposit underlies the Chester sandstone.

The thickness of the conglomerate in this region varies from 80 to 125 feet with a general average of about 105 feet.

An excellent exposure of nearly 600 feet of Pennsylvanian rocks is found in the 90-foot cut along the Louisville & Nashville Railroad 1 mile north of Crofton, just

east of this quadrangle. The edges of the strata are upturned by an east-west fault. At the main fault on the south the strata stand vertical in the fault plane and gradually flatten out to the north until the dip is interrupted by another parallel fault. The relation of the conglomerate to the upper members of the Chester and the lower rocks of the Pennsylvanian is shown in the following section from north to south:

Section of Deep Cut One Mile North of Crofton.

	Feet	Inches
1. Thin sandstone .....	10	
2. Limestone .....	3	
3. Shale .....	25	
4. Sandstone .....	15	
5. Coal .....	0	6
6. Sandstone and shale.....	10	
7. Siliceous shale .....	15	
8. Gray clay shale .....	40	
9. Gray sandstone .....	30	
10. Ferriferous sandstone .....	1	
11. Gray sandstone .....	20	
12. Iron conglomerate .....	1	
13. Hard shale .....	4	
14. Bright black coal.....	0	6
15. Shaly sandstone .....	7	
16. Shale .....	4	
17. Thin coal .....		
18. Iron ore band .....	0	6
19. Shaly sandstone .....	6	
20. Shale .....	6	
21. Coal .....	0	6
22. Shale .....	0	9
23. Coal .....	0	2
24. Shale .....	9	
25. Iron stained sandstone .....	2	
26. Shale .....	2	
27. Coal .....	0	2
28. Iron stained sandstone .....	4	
29. Soft shale .....	55	
30. Sandstone .....	4	
31. Soft shale .....	150	
32. Sandstone, upper 10 inches ferruginous .....	10	
33. Sandstone interbedded with equal amount of shale..	20	
34. Conglomerate, pebble-bearing sandstone.....	105	
35. Base of Pennsylvanian and top of Chester .....		
36. Limestone .....	0	3

	Feet	Inches
37. Sandstone upper 10 feet interbedded with shale.....	70	
38. Dark iron conglomerate .....	3	
39. Blue shale with thin bands of sandstone.....	17	
40. Blue limestone.....	20	
41. Blue calcareous shale .....	10	
42. Gray to blue limestone upper 4' yellow .....	12	
43. Blue shale .....	30	
44. Thin bedded sandstone.....	20	
45. Gray shale .....	12	
46. Dark blue to gray sandstone containing iron pyrite	8	
47. Blue shale.....	16	
48. Thin bedded sandstone with shale partings.....	30	
49. Sandstone, massive .....	8	
50. Iron conglomerate sandstone with quartz grains...	3	
51. Blue to gray limestone with shale.....	70	
52. Blue shale .....	20	
53. Limestone with shale partings.....	5	
54. Blue shale .....	40	
55. Thin bedded limestone.....	10	
Fault plane.		
Total .....	964	4

As seen from the above section there are 561 feet four inches of Pennsylvanian and 403 feet of Chester rocks exposed. It is quite probable that the limestone, which is shown in No. 2, at a distance of 551 feet four inches above the bottom of the Pennsylvanian, is the limestone which occurs about forty feet above the Empire coal which is now being operated at the old Empire mine 1 mile to the north.

The rocks included between the top of the conglomerate sandstone and the horizon of No. 9 coal are a series of sandstones and shales with two or three thin limestones and one or two workable coals.

**SUB-CONGLOMERATE COAL.**—At a number of places in the Dawson Springs quadrangle is a thin coal which comes at or near the base of the Pennsylvanian series and is known as the "Sub-conglomerate coal." It outcrops and has been opened in a number of places on Montgomery and Cany Creeks. Near Mr. James B. Haile's house,  $1\frac{1}{4}$  miles east of Piny Creek and just north of the Haile fault, this coal is now being worked. It occurs in a bed of gray shales with the conglomerate

sandstone close above and the Chester limestone close below it. The coal at this place is 3 feet in thickness.

A coal at this horizon occurs generally along the border of the western coal field.

**EMPIRE COAL.**—The lowest workable coal, except the sub-conglomerate coal, is the one which is now being mined at Empire and is known as the Empire coal. As far as can be determined by surface exposures of the rocks in that region its geological horizon is about 560 feet above the base of the Pennsylvanian rocks. Measurements of the strata outcropping in the hills between Empire and the outcrop of No. 9 coal in the region of Saint Charles place the Empire coal 276 feet below No. 9 coal.

The Empire coal is a bright clean coal 34 to 48 inches in thickness, with a general average of 44 inches. It is practically free from sulphur or clay partings. Mother of coal partings are common in all of the mines where the coal is worked. It has a hard gray shale roof which stands with little propping in rooms 22 feet wide. It has a hard clay floor. In the north part of the mine near the base of the coal is a band of cannel coal with a maximum thickness of 7 inches.

The following is an average section of the mine where the cannel coal is present:

	Feet	Inches
Roof, hard gray slate		
Coal .....	1	7½
Mother Coal .....		¼
Coal .....	1	5½
Cannel coal .....		3
Coal .....		3
Total .....	3	7¼

Floor, hard, smooth fire clay.

The roof of the coal is studded with numerous impressions of ferns and reeds.

The relation of the Empire coal to overlying and underlying strata is shown in the following generalized section:

Generalized section in the region of Empire.

	Feet	Inches
Coarse sandstone .....	20	
Shale .....	25	
Hard, blue, fossiliferous limestone .....	3	
Siliceous shale and sandstone .....	40	
Coal, Empire .....	3	8
Fire clay .....	2	
Siliceous shale .....	20	
Clay shale .....	40	
Sandstone .....	40	

The limestone in the above section outcrops in the region between Empire and Mannington and for a distance of 3½ to 4 miles to the west. At practically all of the mines operating on the Empire coal it is found 30 to 45 feet above the coal. At the old Empire shaft it is reported 27 feet above the top of the coal. At the Terry mine, just north of old Empire, it outcrops in the road 45 feet higher than the coal. At the Davis and Woolridge mines it is about 25 feet above the coal. Still farther west at the Campbell mine the limestone is 40 feet above the coal.

**DAWSON SPRINGS COAL.**—In the vicinity of Dawson Springs and for some distance to the east and northeast is a coal that has many of the ear-marks of the Empire coal. It is 46 to 52 inches thick, without parting, but has frequent mother of coal partings. The coal is not sufficiently hard for a good shipping coal, but is considered an excellent steam coal for local use. It contains little or no sulphur. The coal has a gray shale roof, which in most places forms a substantial roof. The shale for a few inches above the coal contains macerated impressions of leaves. The shale above the coal is 40 to 45 feet thick with a coarse sandstone of about the same thickness above the shale. Between the two is a hard blue limestone 2 to 3 feet thick. The coal is underlain by 18 inches of fire clay, beneath which is a hard ganister. Below the ganister comes 6 to 10 feet of shale with a medium coarse-grained cross-bedded sandstone below 30 to 40 feet thick.

The following is an average section of the Dawson Springs coal in the J. W. Workman mine 1 mile north of Dawson Springs:

Roof, dark gray shale	Feet	Inches
Soft coal .....	2	3
Mother coal .....		$\frac{1}{4}$
Harder coal .....	1	2
Hard coal, with some sulphur.....		$9\frac{1}{2}$
Total .....	4	$2\frac{3}{4}$
Floor, hard fire clay.		

The thickness of the Dawson Springs coal is somewhat greater than the Empire coal, but the nature of the roof and bottom of each, and the general stratigraphic relations indicate very strongly that the two coals belong to the same geologic horizon. In the Empire district the limestone which occurs 30 to 45 feet above the coal is apparently the same limestone which is 30 to 45 feet above the Dawson Springs coal.

On the south side of Cany Creek, 1 mile west of Ilsley, is an outcrop of a hard, blue gray limestone which contains numerous macerated fossils. Among others is a large crinoid stem 1 inch in diameter. On the surface are some weathered fragments of a light porous limestone containing more or less blue flint or chert.

At the foot of the little hillock where the limestone occurs is an old shaft which is reported to have been sunk to a 4-foot bed of coal at a depth of 30 feet below the limestone.

The most eastward extension of what appears to be the same limestone occurs on the south side of the large east-west fault 1 mile south of St. Charles. The limestone has been brought to the surface here by the fault. It is a hard, blue to gray limestone containing the large crinoid stem 1 inch in diameter and other marine fossils. It is underlain by shale. Close above the limestone is a coarse grained sandstone.

At a distance of  $1\frac{1}{2}$  miles southeast of Charleston is an outcrop of coal which is 5 feet 4 inches thick without parting, with a soft clay roof and fire clay floor. Thirty feet higher elevation on the same branch is an outcrop of a hard, blue, fossiliferous limestone with a coarse sandstone close above. The following is a section at this place.

Section  $1\frac{1}{2}$  Miles Southeast of Charleston.

	Feet	Inches.
Coarse, medium soft sandstone .....	40 to 50	
Covered, perhaps siliceous shale .....	5	
Hard, blue to gray limestone .....	2 to 3	
Covered, perhaps shale .....	30	
Coal without parting .....	5	4
Shale		

The coal opened at the foot of the hill just west of Charleston is apparently at the same geological horizon.

At the foot of the hill on the north side of Lick Creek on the road leading north of Charleston, is an outcrop of blue limestone 2 feet thick with 20 feet of siliceous shale below and a coarse loosely cemented sandstone 70 feet thick coming close above. This is apparently the same limestone as that coming 30 to 40 feet above the Dawson Springs coal and the coal southeast of Charleston, and if so the coal would be 10 to 15 feet below the level of the bottom on the north side of Lick Creek.

From the above stratigraphic evidence the writer believes that the coal now worked at Empire, Dawson Springs and in the two openings near Charleston, is at the same geological horizon. The above correlation was also suggested by Glenn in Bulletin No. 17, Kentucky Geological Survey.

On the west side of Tradewater, west of Dawson Springs, and in the region east of the river on a line between White's schoolhouse and Charleston, is a chert horizon which is 40 to 45 feet below the Dawson Springs coal. The chert bed is about 10 feet thick. It is formed of thin layers of a siliceous limestone which is studded with marine fossils. On exposure to the weather it loses its lime content and separates into thin slabs of a dirty brown to yellow color. After it is thoroughly weathered it is very porous and light to the touch.

The chert is well exposed in the road leading west of Dawson Springs, in Caldwell County, and again on the high hill on which White's schoolhouse stands, 1 mile north of the Princeton road. Before reaching the 500 foot level, 1 mile north of White's schoolhouse, an east-west block fault cuts off the chert to the north, the south side being faulted down.

The same chert outcrops just back of I. T. Beshear's house, 2 miles northwest of Dawson Springs. An unconformity or a fault brings the chert bed and the limestone which occurs normally about 80 feet above the chert, near the same elevation at this place. The chert occurs again in the woods on the north side of the south fork of Bull Creek, 3 miles due north of Dawson Springs. The bed is about 15 feet thick and carries an abundance of fossils.

The relation of the Dawson Springs coal to the limestone above and chert below is shown in the following general section:

Generalized section in the region of Dawson Springs.

	Feet	Inches
Sandstone .....	30 to 40	
Shale .....	10	
Limestone .....	2 to 3	
Shale .....	30 to 45	
Coal (Dawson Springs).....	4	
Fire clay .....	1	6
Shale .....	10	
Sandstone .....	30	
Chert .....	10 to 15	
Shale and sandstone .....	40	
Sandstone, cliff forming .....	40	
Shale .....	6	
Sandstone .....	12	
Iron conglomerate .....	1	
Dark gray shale .....	8	
Thin coal .....	0	6
Shale .....	5	
Sandstone .....		

**ROCKS BETWEEN DAWSON SPRINGS COAL AND NO. 9 COAL.**—The interval between the Dawson Springs coal and No. 9 coal is approximately 276 feet, as shown in the following generalized section. The predominating material is shale with almost an equal thickness of sandstone with one persistent limestone, 30 to 40 feet above the Dawson Springs coal, and two thin limestones that are not everywhere present. The interval contains three thin coals that rarely attain workable thickness.

Generalized section between Dawson Springs coal and No. 9 coal.

	Feet	Inches
Coal, No. 9 .....	5	
Shale .....	12	
Sandstone .....	12	
Siliceous shale .....	40	
Slaty shale .....	5	
Black slate .....	3	
Coal, No. 8-b .....	0 — 3	
Black shale .....	0 — 6	
Argillaceous limestone .....	0 — 2	
Fire clay or gannister .....	2	
Loosely cemented sandstone .....	40	
Coal .....	1	
Fire clay .....	2	
Sandstone .....	15	
Argillaceous limestone .....	0	6
Coal .....	4	
Fire clay .....	3	
Shale .....	30	
Coarse sandstone (Curlew) .....	40	
Shale .....	5	
Limestone .....	2	
Shale .....	40	
Coal (Dawson Springs) .....	4	
	276	6

The first sandstone above the Dawson Springs coal is a coarse, loosely cemented sandstone that corresponds to the Curlew sandstone of Owen. It is about 40 feet thick, and where the entire thickness is above drainage it forms precipitous bluffs. In many of the cliffs are large recesses or caves due to the unequal weathering of the sandstone. This sandstone forms steep hills along the river on the northwest side of Dawson Springs and for a distance of 1 mile to the north. It caps the tops of the hills on which Charleston stands and forms steep cliffs on the head waters of Lick Creek between Charleston and Huckleberry school house and extends to the large east-west fault 1 mile south of Charleston. The north-east dip carries it below drainage  $\frac{1}{2}$  mile west of Huckleberry school house and later formations form the surface to the north and east.

What appears to be the same sandstone occurs along Buffalo Creek along the southern border of Hopkins County near the center of the quadrangle. It is there a loosely cemented sandstone and is underlain by a thick bed of shale. The dip of the rocks is to the north and carries the sandstone below drainage between Buffalo Creek and Gilliland school house and brings to the surface the thick shale interval which is in turn overlain by another sandstone. A higher sandstone forms the body of the hills between Gilliland school house and the large east-west fault 1 mile south of St. Charles.

The first coal above the Dawson Springs coal is a coal that in places attains a workable thickness. It is 3 to 4 feet thick without parting except mother-of-coal. It has a shale roof with a gray micaceous bottom which contains small strap leaf and grass impressions. The coal is soft but contains little sulphur and is regarded as a good domestic coal.

The coal has been opened in a number of places on the headwaters of Buffalo Creek, southwest of Martin's Chapel. This coal was correlated by Glenn as the Empire and Dawson Springs coal. The shale above the Empire coal is from 30 to 40 feet thick, with a limestone between the shale and a coarse sandstone above. In the coals above referred to the shale above the coal is only 4 to 5 feet thick with a coarse sandstone above.

There are three old openings on this coal in the region of Ilsley and Hamby stations. One is on the west side of the high hill  $1\frac{1}{2}$  miles south of west of Ilsley at an elevation of 470 feet. The coal where opened is 4 feet thick under a shale roof. On a direct line between this opening and Ilsley, and  $\frac{1}{2}$  mile distant, the Dawson Springs coal, with the limestone 30 feet above, is reported to have been opened on the south side of Cany Creek. The outcrop of the limestone at the latter place is 70 feet below the coal on the hill.

The same coal has been opened on the east side of the road  $\frac{3}{4}$  mile south of Hamby station. This is known as the Jesse Robertson coal.

## Section of Jesse Robertson Coal.

	feet	Inches
Gray shale ..		
Dark shale . . . . .	4	— 6
Sulphur band . . . . .		thin
Coal . . . . .	3	6
Gray soft micaceous ganister which becomes very hard 2 feet below the coal.		

The ganister is filled with small strap-leaf and grass impressions. Twelve feet below the base of the coal is the top of a fine grained sandstone.

What appears to be the same coal has been opened on the Toy land 1 mile southeast of Hamby station. The coal is 43 inches thick without parting. It has a gray shale roof and a fire clay floor filled with strap-leaf impressions similar to the Jesse Robertson coal. The lower 11 inches of the shale roof is hard and forms a good roof. Between it and the softer shale above is a 1-inch band of carbonaceous shale. The roof contains numerous well preserved impressions of ferns and reeds. The elevation of the coal is approximately 470 feet.

What is here regarded as the same coal has been opened at the Z. T. Cox bank,  $2\frac{1}{2}$  miles due west of Charleston, at an elevation of 545 feet. The coal is 3 feet 4 inches thick where opened. It has a gray siliceous shale roof which grades upward into a shaly sandstone. The roof contains narrow strap-leaf and fern impressions. About 25 feet above the coal is a thin ferruginous sandstone which is filled with clay concretions. In places the clay has weathered out, leaving the iron ore rock full of rounded pit holes. Immediately below the coal is a bed of fire clay 3 feet thick and below this 1 foot of ferruginous sandstone.

In the hollow just north of the Cox bank and 60 feet below it a small fragment of limestone was found which may be the horizon of the limestone above the Dawson Springs coal.

The second coal above the Dawson Springs coal is a thin coal which comes directly beneath a loosely cemented sandstone. At no place in the district was it found to be of workable thickness. Its horizon is about 125 feet be-

low No. 9. It outcrops in the Carbondale and Madisonville road half way between Carbondale and Southard school house. The only other place where it is known to occur is on Mr. Silas Franklin's field opposite the mouth of Fox Run, about half way between Saint Charles and Daniel Boone. Coal 8-b has been opened further up the same branch at 50 feet higher elevation.

COAL 8-b.—A coal that has been described by Glenn, Norwood and others as 8-b, outcrops in a number of places in the northern third of the Dawson Springs quadrangle. It occurs 70 to 100 feet below No. 9, in the region under discussion, with a somewhat smaller interval in the region to the north.

It is characterized by a black carbonaceous shale which comes immediately above the coal. To the casual observer the slate resembles the black slate above No. 9 coal. As a mark of distinction between the two it may be stated that the slate above the lower coal comes out in larger, smoother blocks or slabs and is more resistant to the weathering agents than that above No. 9 coal. The resemblance to the black slate above No. 9 coal, in places, is further shown to the extent of having similar macerated marine fossils and shark's teeth.

The coal at this horizon is not everywhere present. In places it is represented by this black slate and the fire clay and a thin argillaceous limestone.

The most westward outcrop of 8-b coal in the Dawson Springs quadrangle is  $\frac{1}{2}$  mile north of the Greenville road  $2\frac{1}{2}$  miles west of Crabtree. The coal is 24 to 26 inches thick and has a black slate roof. The dip of the rocks there is south 20 degrees west. One mile southeast of the above mentioned location, in the bed of a branch flowing south, coal 8-b has been worked by stripping off the black slate. The coal is 24 to 26 inches thick and comes out in large blocks. The coal is a hard black non-smut coal, without parting except mother-of-coal. It is said to be an excellent shop coal.

Coal 8-b has been opened on the side of the Greenville road on the west side of the first branch west of Copperas branch. The following is a section at the old opening:

Section 1 mile west of Copperas creek, on Greenville Road.

	feet	Inches
Siliceous shale .....	35	
Slaty shale .....	5	
Black slate—dry .....	1	
Clay .....		4
Coal, No. 8-b .....	2	1
Clay parting .....		$\frac{1}{2}$
Coal .....		

What is probably the horizon of coal 8-b is shown in the following section 1 mile northwest of Crabtree at an elevation of 460 feet. At this place the black slate and the underclay are present but the coal is wanting.

Section 1 mile northwest of Crabtree.

	feet	Inches
Black slate .....	4	
Black shale .....		10
Argillaceous limestone .....	2	6
Gray ganister .....		

In the faulted block in which Daniel Boone is located, coal 8-b has been opened in a number of places as far west as Saint Charles. The elevation of 8-b coal south of the Saint Charles fault is about the same as that of No. 9 coal, north of the fault. When the former was first opened it was thought to be the No. 9 seam, but the thickness of the coal in most places was found to be less than half that of No. 9 coal and the openings were all abandoned.

In the faulted block in which Saint Charles is located, coal 8-b occurs on the east side of the branch 1 mile northwest of Daniel Boone at an elevation of 475 feet.

An excellent exposure of coal 8-b with its overlying black slate is exposed in the bed of a branch on the east side of the road,  $\frac{3}{4}$  of a mile south of Southard school house. It is here 120 feet lower than No. 9 coal which has been opened at an elevation of 580 feet at the north end of the hill  $\frac{3}{4}$  of a mile to the northeast.

Coal No. 8-b has been uncovered in the branch on Mr. Thomas Davis' land,  $1\frac{1}{4}$  miles northwest of Carbon-

dale. The opening is a short distance north of an east-west fault which brings the No. 9 coal, on the south side of the fault, about 20 feet below the level of No. 8-b coal on the north side.

**No. 9 COAL.**—The area underlain by No. 9 coal in the Dawson Springs quadrangle comprises a narrow belt of territory 1 to 2 miles wide and  $9\frac{1}{2}$  miles long in the northern part of the quadrangle. The long axis of the belt extends westward from the main body of No. 9 coal which lies farther to the east.

The presence of No. 9 coal in this quadrangle is largely due to a series of east-west, down-thrown block faults which, by reason of the blocks containing the coal having dropped, have extended the western crop line of the coal and preserved it from erosion. The northern as well as the southern boundaries of the coal are, therefore, largely limited by faults, with extensive smaller faults between.

The main body of the coal lies just south of the Bishop fault on the north with finger-like projections extending southward under the north-south ridges.

North of the Bishop fault are a few small outliers in which the coal has either been worked out or lies too near the surface to be worked, except as local banks.

The line of outcrop of the coal and the location of the faults, which are shown in solid and broken lines, are shown on the map accompanying this report.

In thickness, quality and freedom from mining troubles over an extensive area, No. 9 coal holds first rank among the coals of Western Kentucky. No. 11 coal where mined is usually from 1 to 3 feet thicker than No. 9. The Bell coal, the Empire coal and some of the other thinner coals may show a better quality on analysis, but the No. 9 can be relied on as a better mining proposition.

In the Crabtree-Saint Charles district the thickness of No. 9 coal varies from 4 feet 6 inches to 5 feet with a general average of 4 feet 7 inches. It is free from partings and troubles in roof and floor, except where the coal may be shattered and displaced by faults. The roof is invariably a firm black slate 2 to 3 feet thick and over this a gray shale. The floor, in most of the mines, is

a hard fire clay, sufficiently firm to hold the over burden and the tracks.

No. 9 is the hardest coal of Western Kentucky and is a good shipper. Where it is machine mined about 40 per cent. is lump, and 60 per cent. nut and slack.

All the mines operating No. 9 coal in the Crabtree-Carbondale district are drift mines. Except in a small faulted area north of Crabtree the coal is above drainage. In the area where present it generally occurs sufficiently near the base of the ridge to give a sufficient overburden that practically all of the coal can be worked. In almost one-half of the area where No. 9 exists the coal outcrops sufficiently low in the hills to include a small area of No. 11 above No. 9. Except for the presence of a few small faults of the district, the area underlain by No. 9 coal has by reason of the ease with which the coal can be mined, the thickness and quality of the coal, and its accessibility to transportation, become a valuable asset to this part of Hopkins County.

**DETAILED DESCRIPTION.**—The most westward extension of No. 9 coal, in the Dawson Springs quadrangle, is in a faulted block at a point about 1 mile south of Charleston. The coal occurs under the high east-west ridge in a belt  $\frac{3}{4}$  of a mile wide and is delimited on the north and south by east-west faults. At a point about  $\frac{1}{2}$  mile east of the most westward outcrop the ridge is sufficiently high to catch the outcrop of No. 11 coal, which extends with only one small break eastward to 1 mile west of Carbondale.

No. 9 coal has been opened on the north side of the hill at a point 1 mile west of the old Bishop mine at an elevation of 520 feet. No. 11 and No. 12 coals, with the limestone between, outcrop near the crest of the hill. No. 9 coal is only 63 feet lower in elevation than the outcrop of No. 11 and the top of the sandstone above No. 9 coal is at the same elevation as the No. 11 coal on the south side of the hill, 200 yards distant. The above indicates a strong dip to the south. There is also an eastward dip due to the large fault on the north plunging eastward. The following is a section of the hill at that place:

## Section 1 mile west of the old Bishop Mine

	feet
Coal, No. 12.....	thin
Shale .....	4
Limestone .....	7
Coal, No. 11.....	18
Shale .....	30
Sandstone .....	15
Shale .....	
Coal, No. 9, opening closed.	

About  $1\frac{1}{2}$  miles south of east of Charleston, on the west bank of the branch which forms Lick Creek, and a short distance north of Bishop fault is a coal which has been opened at an elevation of 440 feet. This coal is just 80 feet lower elevation than No. 11 coal which has been opened near the crest of the hill  $\frac{1}{2}$  mile to the south. The lower coal is 5 feet 4 inches thick without parting. On account of its thickness and position with reference to No. 11 coal the lower coal is thought by some to be No. 9 coal. On close examination it is found to have a soft clay-shale roof which is never found above No. 9 coal. It contains less sulphur and more mother-of-coal and is much softer than No. 9 coal. As a matter of fact it is the Dawson Springs or Charleston coal, which is 275 feet stratigraphically lower than No. 9 coal. Between the lower coal and the opening of No. 11 coal above referred to, is a fault south of which No. 9 coal has been faulted down to the level of the lower coal. It is quite certain that there is no No. 9 coal north of the faulted block, above referred to in the Dawson Springs quadrangle, to the west of the high ridge which lies 1 mile east of Southard school house.

The outcrop line of No. 9 coal from the western end of the faulted block in which the old Bishop mine is located to Crabtree is an irregular line broken by two faults, as shown on the map. Additional faults of smaller displacement in this region have further complicated and disturbed the coal. From Crabtree to Carbondale the outcrop line of the coal follows approximately the 420-foot contour line. The only exception to this is on the two north-south ridges east of Crabtree where the southward extension of the coal has been abruptly cut off by the Crabtree-Dozier Hill fault, to be described later.

The Crabtree Coal Mining Company, Postoffice Ilsey, is the most westward of the three large mines operating No. 9 coal in the Dawson Springs quadrangle. The mine is located 2 miles north of Ilsey station. A spur from the main line of the Illinois Central Railroad at Ilsey to the tippie,  $\frac{3}{4}$  of a mile west of the mine, affords transportation for the coal. The coal is conveyed from the mine to the tippie in mine cars drawn by a small steam locomotive.

The mine is opened on the outcrop of the coal near the head of a small branch at an elevation of 520 feet. The main entry is driven north 5 degrees east on the dip of the coal. The thickness of the coal varies from 4 feet 6 inches to 5 feet. It has a tough black slate roof 2 feet thick and a hard fire clay bottom.

The main and cross entries are worked on the double entry system and the rooms, as far as possible, are turned up the dip of the coal.

The mine is equipped with ten Harrison's air-puncher machines for undercutting the coal and the holes drilled with air drills. Three drill holes, charged with FF black powder to each room of standard width, are used for knocking down the coal. Animal haulage is used for collecting the coal, which is then conveyed to the head of the main slope entry by means of three 10-ton motors. A tail-rope haul, 3,000 feet long is used on the main slope entry. The output of the mine is 600 tons of coal a day. Exact figures for the total output in 1913 could not be obtained, but it was approximately 100,000 tons.

Three faults approximately parallel and having a trend of N. 83° to N. 85° E. have been encountered in the Crabtree mine. The one farthest south is shown on the map at a distance of nearly  $\frac{1}{2}$  of a mile north of the mouth of the main entry. Where it was first encountered the displacement in the coal was 17 feet. The amount of displacement decreases eastward and increases westward giving a westward plunging of the axis. When the fault was encountered the entry was turned eastward until a point was reached where a break was made through the fault, striking the coal on the north side only a few inches lower than it was on the south side. At a point

1,600 feet farther north another small fault was encountered with conditions similar to the first. At a point 600 feet north of the second fault a third one was encountered. The amount of displacement in the last fault has not been determined, but from the elevation of No. 11 coal near the pump house and at an opening in a deep ravine leading north of west of Carbondale, it is about 50 feet near the eastern border of the Crabtree property. Since there is a normal dip to the north it is probable that the actual displacement near the pump house of the Crabtree mine is between 40 and 50 feet.

In the small outlier of No. 9 coal, on the first high ridge west of the Crabtree mine, is a country bank opened on No. 9 coal and known as the Jackson bank. The mine is operated only a portion of the year for the surrounding wagon trade. The opening is on the east side of the hill at an elevation of about 525 feet. The coal is 57 inches thick without parting and has a black slate roof and fire clay floor. The roof contains a large number of "nigger heads" 6 to 12 inches in diameter. This is the most westward mine in the Dawson Springs quadrangle at present operating No. 9 coal.

From the Crabtree-Dozier Hill fault, 1 mile east of Crabtree, the southern outcrop line of No. 9 coal follows approximately the 520 contour line around the headwaters of Cane Run and south on the east side of the stream to Saint Charles.

The Carbondale Coal and Coke Company is operating a mine on No. 9 coal on the upper waters of Cane Run. The coal is conveyed to the main line of the Illinois Central Railroad over a spur which follows Cane Run from near its mouth to the mine, a distance of 2 miles. There are two drift entries in the coal, No. 1 on the east and No. 2 on the west side of the branch on which the tippie is located. The coal is gathered by animal haulage and conveyed to the tippie by a tail rope system from each entry. Ten Sullivan air-puncher machines are used for undercutting the coal and the drilling is done by Hardsocg hand drills. Three holes to the room, which are 20 feet wide, are used in shooting down the coal.

The coal averages 4 feet 6 inches in thickness without parting. It has a good tough black slate roof and a fire clay floor.

The following is an average section of the mine. Section at face of room No. 9 off 5th east, off 5th north entry, 5,000 feet from the entrance. Depth below the surface where sample was taken 60 feet.

	Feet	Inches
Roof, black slate		
Coal	1	0
Mother coal	0	$\frac{1}{4}$
Coal	1	$2\frac{1}{2}$
Sulphur band	0	$\frac{3}{4}$
Coal streaked with sulphur	2	$4\frac{1}{2}$
Total	4	$7\frac{1}{2}$
Floor, hard smooth fire clay.		

North of the main opening the coal has a slight northward dip which increases more rapidly farther in. It is quite certain, however, that the dip will reverse, showing a southward dip, before the large Bishop fault, which occurs  $\frac{1}{2}$  mile north of the mine mouth, is reached.

The faults, which are a disturbing factor in the region north of Crabtree, have faded out to the east before Carbondale is reached, as none have been encountered in this mine. The output of the mine is 525 tons of coal a day. The output for the year 1913 was 87,977 tons.

The region between Cane Run and Fox Run, as shown on the map as being underlain by No. 9 coal, has been entirely mined out and the old mine abandoned. The mine from which the coal was mostly recovered was located on the south side of Dozier Hill, 1 mile north of Saint Charles. The mine equipment that was used at the Saint Charles mine was removed to the Fox Run mine.

The Fox Run mine is owned and operated by the Saint Bernard Mining Company, of Earlington. The mine is connected by a spur, nearly 2 miles long, to the main line of the Illinois Central railroad at the mouth of Fox Run,  $\frac{3}{4}$  of a mile east of Saint Charles.

The mine is opened by drift on No. 9 coal at an elevation of about 520 feet. The average thickness of the coal is 4 feet 6 inches with a black slate roof and fire clay floor.

The following is a general section of the mine. Section at face of 15th east entry 3,000 feet from the entrance:

	Feet	Inches
Roof, black slate	2 to 3	
Coal adhering to roof.....		1
Hard coal .....	1	5
Mother coal and sulphur.....		1
Hard coal .....		9½
Mother coal .....		½
Hard coal with thin irregular sulphur bands....	2	5
Total .....	4	10
Floor, hard smooth fire clay.		

North of the main opening the dip is to the north; south of the main opening the dip is to the south.

No. 11 coal has been opened in the hill 75 feet higher than No. 9. At a point  $\frac{3}{4}$  of a mile north it is 33 feet lower, giving a northward dip of nearly 1 per cent.

The Bishop fault, which passes 1 mile south of Charleston and  $\frac{1}{2}$  mile north of Carbondale mine, is  $\frac{3}{4}$  of a mile north of Fox Run mine. No faults have been encountered in the Fox Run mine between the Crabtree-Dozier Hill fault and the Bishop fault above mentioned.

The coal in the Fox Run mine is undercut by 16 air-puncher machines of the Harrison type, and the drill holes cut by Jeffrey rotary air drills. The mine is worked by the double entry system, with rooms 22 feet in width. Three holes  $4\frac{1}{2}$  feet in depth and charged with 10 to 12 inches of FF black powder are used to break down the coal. Animal haulage is used to gather the coal to the main entries and is then conveyed to the tipples by 2 electric motors, 1 of ten and 1 of twelve tons capacity. The output of the mine is 1,000 tons of coal a day.

The faces of the coal extend east and west and the butts north and south. In shooting the coal advantage is taken of the fault slips which extend northeast and southwest. Where the rooms extend north and south

(See figure 2) the greatest efficiency is obtained in first shooting the center hole lightly so as to barely crack or spring the fault slip, following with a heavy shot on the

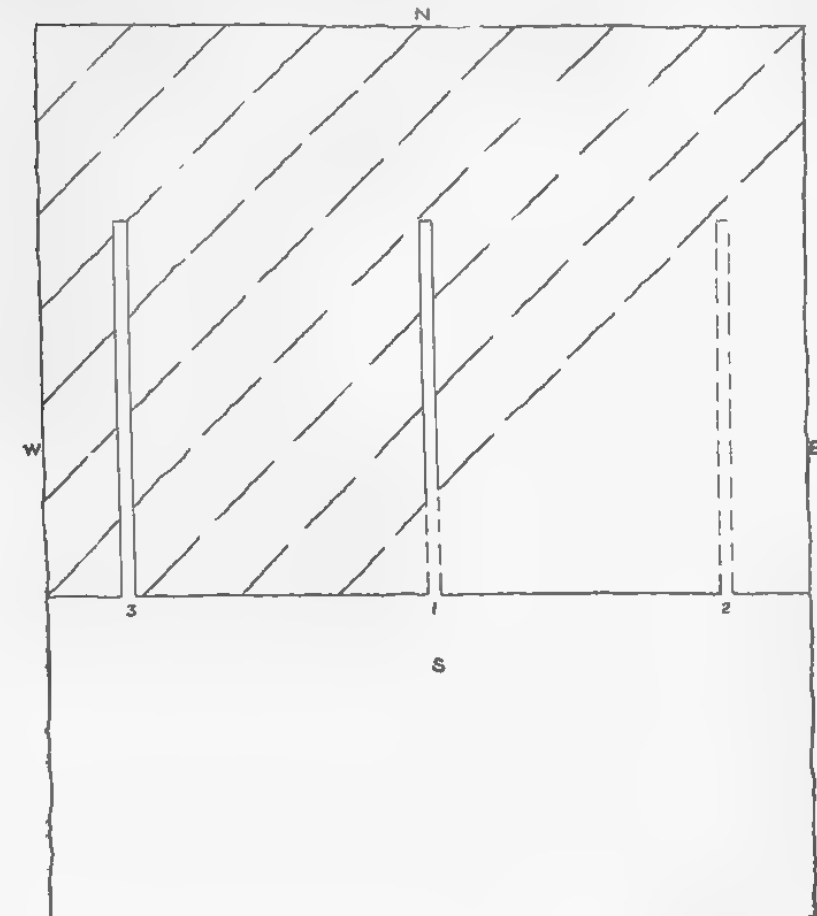


Figure 2.

right side of the room and the last shot at the left. Where the rooms extend east and west (See figure 3) the greatest efficiency is obtained in first shooting the center hole, as described above, following with a heavy shot on the left side of the room, and the last shot on the right. The output of the Fox Run mine for the year 1913 was 214,138 tons.

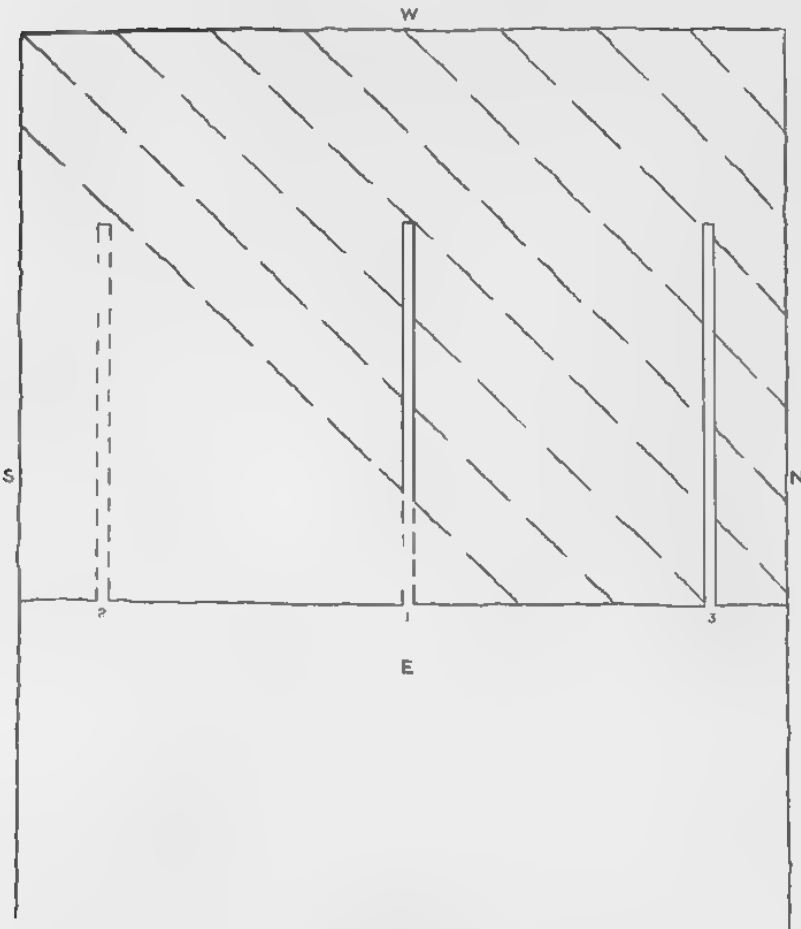


Figure 3.

The outcrop of No. 9 coal occurs at intervals from Fox Run mine southward on the east side of Saint Charles where the Saint Charles fault cuts off the extension to the south.

From the Dozier Hill fault to Fox Run mine there is a slight dip to the north. In the block between the Dozier Hill fault and the Saint Charles fault there is a strong dip to the south. The strata north of the Saint Charles fault dip to the fault, which in the region between Pleasant Run and Cane Run, is plunging westward.

Just south of the public road leading east of Saint Charles, at a point  $\frac{1}{2}$  mile west of Pleasant Run, No. 9 coal is being worked at an elevation of 515 feet. About 1 mile southwest on same road at the foot of the hill east of Fox Run, No. 9 coal is well exposed in the road at an elevation of 465 feet. About 1 mile due east of the latter place the same coal is exposed in the Saint Charles fault at an elevation of about 500 feet.

A number of years ago an effort was made to open a mine on No. 9 coal a few feet north of the Saint Charles fault at a point  $1\frac{1}{2}$  miles east of Saint Charles. The mine was known as the Caney Creek mine. The fault at this point has a bearing of N. 80 degrees east. Just south of the fault is a cliff of sandstone 25 feet high with shale abutting against the sandstone on the north. The opening on the coal was made 100 feet north of the main fault. The coal was worked for about 1 year and was finally abandoned on account of the badly broken condition of the coal. Blocks of limestone are still found at the mine. According to Mr. C. J. Norwood,\* who visited the mine when it was in operation, there were 6 faults in a distance of 537 feet. At one place the coal was 9 feet above and at another place 10 feet below the level of the coal at the mouth of the main entry. The faults in the coal described by Mr. Norwood are secondary adjustment block faults which are north of the main fault.

At Cowhorn Spring,  $\frac{1}{2}$  mile east of the old Caney Creek mine, No. 9 coal is exposed in the Saint Charles fault under conditions similar to those at Caney Creek mine. The main fault here was attended by a cross fault, N. 15° W., in which the coal was brought to the surface. The down throw of the cross fault is on the east side, but is apparently of small displacement.

The outcrop line of No. 9 coal from the Saint Charles fault west of Pleasant Run to where it leaves the quadrangle  $2\frac{1}{2}$  miles east of north of Daniel Boone, is less disturbed than in the region to the west. It follows approximately the 520 feet contour line. North of the road leading east from Saint Charles No. 11 coal outcrops up near the top of the ridges 80 to 90 feet above the outcrop of No. 9 coal.

\*Ky. Geol. Survey, Part VI, Vol. I, Second Series, 1876.

No. 9 coal at Fox Run mine is at an elevation of 520 feet. At a point one mile due north on the west side of the high ridge it outcrops at an elevation of 590 feet. The difference in the elevation of the same coal at the two places is due to the Bishop fault which passes  $\frac{3}{4}$  of a mile north of the Fox Run mine and drops the south side down about 70 feet.

At the north point of the ridge two miles due north of Fox Run mine, No. 9 coal has been opened at an elevation of 580 feet. The coal is 4 feet 10 inches thick.

In the small outlier one mile southwest of the northeast corner of the quadrangle, No. 9 coal has been opened at an elevation of 560 feet. At the old Barnsley mine, which is located just north of and  $\frac{1}{4}$  of a mile from the northeast corner of the Dawson Springs quadrangle, No. 9 coal was opened at an elevation of 546 feet, giving a northeast dip in this region of about 15 feet to the mile.

No. 9 coal has been worked in one locality south of the Saint Charles fault. This is on the headwaters of Caney Creek,  $\frac{1}{2}$  mile west of Daniel Boone. A large fault  $\frac{1}{4}$  of a mile south and another about the same distance north of Daniel Boone mine, confines No. 9 to a narrow east-west strip.

No. 9 coal dips rapidly eastward from where it outcrops on the small branch just west of the Daniel Boone mine and is not encountered in the wells at that place. No. 11 coal, which is the coal now worked at the Daniel Boone mine, is 30 feet below the surface at the mine shaft. At a point  $\frac{1}{2}$  mile east of the Boone mine the coal has dipped to 130 feet below the surface. The strong westward rise of the strata carries No. 9 coal above the top of the ridge one mile west of Daniel Boone.

In the faulted block in which the town of Saint Charles is located there is some complicated cross-faulting which is not clearly understood. No. 8-b coal has been opened in a number of places in this block south and east of Saint Charles, and at two places on the headwaters of Caney Creek, one mile northwest of Daniel Boone. At a point one mile west of Saint Charles, at the foot of the hill east of Cane Run, in the Dawson Springs road, No. 11 coal shows the following section:

## Section in road 1 mile west of Saint Charles.

	Feet
Thin sandstone .....	
Soft shale .....	30
Coal, No. 12 .....	4
Limestone .....	3
Coal, No. 11 .....	5
Gray clay	

The sandstone above the coal dips strongly N. 60° to 70° E. The high hills to the east and also to the west of Saint Charles are composed largely of soft aluminous shales which apparently belong above No. 11 coal. Whether the shales above referred to belong above or below No. 11 coal it is quite certain that No. 9 coal will be found in the area where No. 11 comes to the surface and perhaps for a short distance west. There is much doubt as to its eastward extension in the Saint Charles block. It is quite possible that the presence of No. 11 coal between Saint Charles and Cane Run is due to some cross faulting that does not appear at the surface.

ROCKS ABOVE NO. 9 COAL.—In the Dawson Springs quadrangle are 170 to 200 feet of Pennsylvanian rocks above No. 9 coal. These include two coals, Nos. 11 and 12, the former of which is the thickest coal of the region. No. 12 coal so far as known, has never been worked in this region. Forty to forty-five feet above the base of No. 11 coal is a coarse-grained, rough persistent sandstone which is the Anvil rock sandstone of Owen. It caps the tops of all of the hills and ridges where they rise 50 feet or more above No. 11 coal. It occurs in the ridge north of Crabtree, on Dozier hill and in the high ridge east and north of Fox Run mine south of the Bishop fault. It likewise forms the crest of the hill in the northeast corner of the quadrangle, and again in the hill east of Daniel Boone.

The following is a generalized section of the Pennsylvanian rocks in the Dawson Springs quadrangle above No. 9 coal:

## Generalized section of rocks above No. 9 coal.

	Feet
Shale and sandstone .....	50
Sandstone .....	15 — 25
Shale .....	40 — 45

	Feet
Coal, No. 12.....	3 — 4
Limestone . . . . .	4
Coal, No. 11 .....	6 — 7
Siliceous shale and sandstone.....	18
Sandstone .....	30
Shale .....	30
Coal, No. 9.....	5

No. 11 COAL.—No. 11 coal is present throughout the Dawson Springs quadrangle in the hills above No. 9 coal where the hills rise 80 feet or more above the latter coal. Where opened, the coal has a thickness of 6 to 7 feet. It is characterized by a limestone roof and a clay parting or "blue band" about 2 feet from the bottom. No. 12 coal which lies close above the limestone is likewise present in all of the openings observed.

No. 11 has been opened in a number of places in this region, but in all of them, except at the Daniel Boone mine, they were made up near the crest of the ridges and were soon abandoned on account of clay slips and other troubles in the roof. Perhaps the more potent reason why this coal is not more generally worked in this region is because of the presence of the more reliable No. 9 coal which occurs above surface throughout the region where No. 11 coal exists. That the No. 11 coal can be worked at a profit is shown by the fact that it has been mined for a number of years at Daniel Boone. It is quite possible, therefore, that after No. 9 coal of this region is worked out, No. 11 coal will be mined.

DETAILED DESCRIPTION.—The most westward outcrop of No. 11 coal occurs in the faulted block one mile south-east of Charleston. It is so near the crest of the ridge, however, that it is of no economic value.

It was opened a number of years ago and worked as a country mine at the old Bishop mine, the location of which is shown on the map. The coal in the mouth of the old entry is 54 inches thick from the top of the coal to the "blue band." The remainder of the coal is covered with water. It is reported to have been 7 to 8 feet thick in the mine. A limestone 5 feet thick forms the roof of the coal with 2 to 4 inches of gob between. No. 12 coal outcrops on the hill above the limestone.

In a small branch just west of the road, one mile northwest of Crabtree, No. 11 coal outcrops a short distance north of the Union Grove fault. The top of the sandstone above No. 9 coal outcrops 100 yards down the branch.

The limestone, which forms the roof of No. 11 coal, with the No. 12 coal close above it, outcrops in the Madisonville road near the old pump house of the Crabtree mine, one mile northeast of Crabtree. The elevation of the limestone here is 570 feet.

No. 11 coal has been opened and mined for a time at the head of a deep hollow  $\frac{1}{2}$  mile north of the Madisonville road,  $1\frac{1}{4}$  miles due west of the Carbondale mine. The elevation of the coal is 510 feet. The following is a section at the mouth of the mine:

Section of No. 11 coal  $1\frac{1}{4}$  miles west of Carbondale.

	Feet	Inches
Limestone .....	3	
Gob .....	0	6
Black slate .....	1	
Coal .....	4	6
Clay parting, "blue band" .....	0	2—3
Coal .....	2	3

The same coal has been opened  $\frac{1}{4}$  mile farther down the same branch just west of a spring at an elevation of 485 feet, or 25 feet lower than at the head of the branch.

The limestone above No. 11 coal outcrops in a number of places in Dozier Hill, 75 to 80 feet above No. 9 coal.

The Saint Bernard Mining Company opened and operated No. 11 coal for a time in the hill, 75 feet above Fox Run mine. The coal averaged 7 feet in thickness, with a 2-inch clay parting, 2 feet from the bottom of the coal and another thin parting 1 foot from the top. It is claimed that the mine was closed on account of the small demand for coal, which could all be supplied by the No. 9 mine.

The same coal has been opened on the west side of the road  $\frac{3}{4}$  of a mile northwest of Fox Run mine, a few feet south of the Bishop fault which cuts off the north-

ward extension of Nos. 9 and 11 coal from this point west. The coal at the latter place is 33 feet lower than it is at the Fox Run mine.

No. 11 coal underlies the ridge between Fox Run and Pleasant Run for about one mile south of the Fox Run mine and is continuous under the high ridge from about  $\frac{1}{2}$  mile northeast of Carbondale to the eastern boundary of the quadrangle. It likewise outcrops in the first high hill just north of the fault one mile north of Fox Run mine.

It has been opened on the east slope of the ridge  $\frac{1}{2}$  mile east of south of the old Sisk Schoolhouse at an elevation of 600 feet; and again on the old Madisonville road  $\frac{3}{4}$  of a mile south of east of the same schoolhouse at an elevation of 580 feet.

No. 11 coal catches under the high ridge in the northeast corner of the quadrangle. It was opened a few feet north of the northern edge of the Dawson Springs quadrangle, but the mining was attended with so many slips, and limestone boulders falling in, that the mine was abandoned.

No. 11 coal has been opened in two places south of the Saint Charles fault, one on the Doctor Woodruff place, one mile west of Saint Charles, and the other at Daniel Boone. At the former place a small area of coal has been faulted down to an elevation of 435 feet. In Dozier Hill,  $1\frac{1}{4}$  miles to the north, the same coal occurs at an elevation of 620 feet or 185 feet higher. The extent of the Woodruff coal is not known, but it is thought to be confined to a very small area.

No. 11 coal is worked at Daniel Boone in a down-faulted block, which is about  $\frac{1}{2}$  mile in width from north to south. North of this block No. 8-b coal outcrops in a small branch on the headwaters of Caney Creek. A still larger fault occurs about 1,200 feet south of the mine bringing up even younger strata than that exposed in the block north of Daniel Boone. The rocks in the Boone block rise rapidly to the west and bring Nos. 11 and 9 coals to the surface, a short distance west of the mine. At the mine No. 11 coal is 30 feet below the surface and in the eastern edge of the town the eastward dip is reported to have carried the coal down 130 feet below the

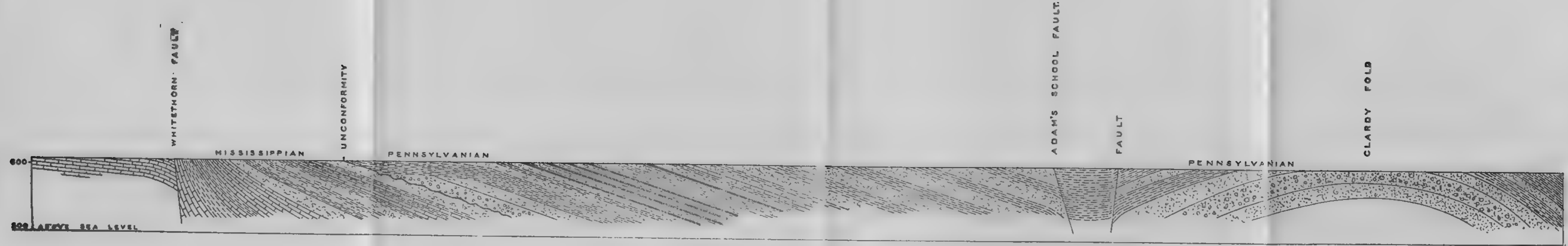


Figure 1.  
 Section in deep cut one mile north of Crofton.  
 Horizontal Scale—1 inch=200 feet.  
 Dawson Springs Sheet.

surface. Just how far this rate of dip continues is not known. Younger formations appear at the surface to the east before Nortonville is reached.

No. 11 coal in the Boone mine is 6 feet to 6 feet 6 inches thick with a 2-inch clay parting 2 feet from the bottom. The roof is limestone with 2 inches to 4 feet of gob between. No. 12 coal occurs above the limestone which is 5 feet 10 inches in thickness. The coal in the mine dips 3 to 4 per cent to the southeast.

The mine is equipped with 5 Morgan Gardner electric chain, breast machines for undercutting the coal. The holes are drilled with hand drills. The mine is opened by slope to No. 11 coal which is 30 feet below the surface. The coal is hauled up the main entry to the surface by the tail rope system. The entire output of coal at this mine, which has a capacity of 400 tons a day, is sold to the Illinois Central Railroad Company. The engines are coaled at this point, which is the last station between Louisville and New Orleans where engines are coaled at a mine. The output for the year 1913 was 95,024 tons.

No. 12 COAL.—No. 12 coal is the highest coal that outcrops in the Pennsylvanian rocks in the Dawson Springs quadrangle. It occurs immediately above the limestone which forms the roof of No. 11 coal. The interval between the two coals in this region varies from 3 to 6 feet with an average of 4 feet. The thickness of No. 12 coal is not as great in this quadrangle as it is in the Earlinton quadrangle, but it is present throughout the region where No. 11 is present. It has not been opened at any place, to the writer's knowledge, but at the few exposures observed and at the Daniel Boone mine the thickness varies from 3 to 6 feet. The roof is a soft shale, which prevents the coal from being mined. Under present conditions the coal is considered of no economic value.

## STRUCTURE.

The broad structural feature of the quadrangle under discussion is a monocline with a general dip to the northeast. The effect of this northeast dip has been to carry the top of the Chester rocks, which form the surface in the southern third of the quadrangle, to about

400 feet below sea level in the northeastern corner of the quadrangle. While the general effect of the northeast dip has been to carry the older formations deeper under the surface as the northeast corner of the quadrangle is approached the dip throughout this distance is not constant. The general dip has been modified by two series of profound faulting crossing the quadrangle in a general east-west direction; and by low folds and minor irregularities due to the irregularity of the beds during deposition and to later differential warping and settling. The prevalent northeast dip is in part the result of deformation.

The district most subjected to minor folding, or else the folds are there most easily detected at the surface, is in the northern part of Christian County, near the center of the quadrangle.

About  $\frac{3}{4}$  of a mile south of Collins' bridge across Tradewater, is the crest of a broad low fold, the rocks dipping north and south from the crest. The southward dip continues for a distance of about one mile. These low folds are present in practically all of the coal mines of the quadrangle. In a number of places in the faulted districts pronounced faults gradually merge into sharp folds, but these will be described more fully under the following head.

**FAULTS.**—The Dawson Springs quadrangle is crossed in a general east-west direction by two series of faults, one largely in the southern third and the other largely in the northern third of the quadrangle. The general effects of the faults and dip are shown in the north-south cross section from A to B, figure 4.

The faults in the southern area are a combination of normal or stress faulting and lateral or overthrust faulting. In the latter or overthrust faulting the force was exerted from the north. The lateral pressure was barely sufficient in most instances to barely break the folds. At one locality, however, the pressure from the north was so great that a bed of shales, overlying the basal Pennsylvanian sandstone was shot over the basal Pennsylvanian sandstone and a part of the upper Chester sandstone for a distance of more than 100 feet. (See figure 1, section in deep cut, one mile north of Crofton.) The Clardy fold, as shown at the right of the figure, be-

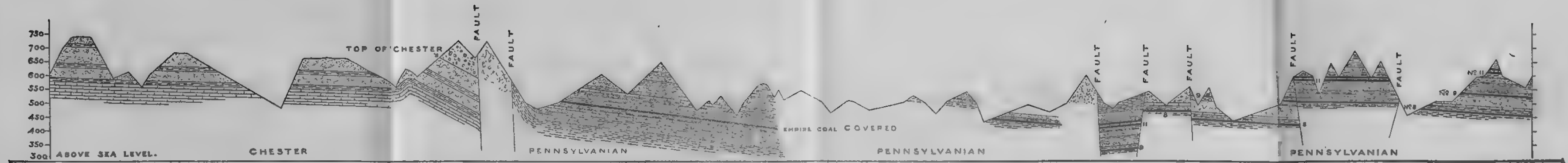


Figure 4.  
Cross Section on Line A-B.  
Dawson Springs Sheet.

comes a pronounced fault a short distance west of this locality. The Whitethorn fault, shown at the left of the figure, at a point one mile to the west, becomes a sharp fold. The Mississippian limestones and shales are shown to the left of and for a short distance to the right of the Whitethorn fault. The basal Pennsylvanian, shown as a pebbly sandstone in the left half of the figure, has a steep dip to the north, but appears again at the surface farther north in the Clardy fold.

The Claxton and Haile faults, which enter the Dawson Springs quadrangle from the Princeton quadrangle on the west, possess the same property as that described in the Clardy and Whitethorn faults.

The Clardy fault is named from the postoffice through which it passes. Its general trend is N. 85° E. In the regions of Clardy and Pod it assumes the nature of a broken fold. Farther east is a clear break. Still farther east, as shown in the figure, one mile north of Crofton, it again takes the nature of a fold.

The amount of displacement in the Clardy fault is difficult to determine. The rocks on the south side from Pod to Clardy are Chester limestones. From there to the eastern edge of the quadrangle the rocks on either side of the fault are Pennsylvanian.

The dip of the strata in the fault varies from a low angle on the folds to nearly vertical where the displacement is greatest. One mile west of the eastern edge of the quadrangle the strata at a point  $\frac{1}{4}$  mile north of the fault dip north at an angle of 25 degrees. The dip gradually flattens to the north for more than a mile before it becomes normal. Less than a mile north of the fault the Empire coal, which is about 550 feet above the base of the Pennsylvanian rocks, outcrops at the surface.

The Adams school fault is a normal fault from the railroad cut north of Crofton to Adams schoolhouse. From there to the west it gradually fades out and finally loses its identity before Concord church is reached. The general trend is about N. 80° E.

The Whitethorn fault has been exposed in the railroad cut one mile north of Crofton where it has the appearance of a normal fault with the down throw on the north. The force attending the faulting came from the north, as shown by the shales 400 feet north of the fault

in the lower Pennsylvanian being thrust southward over the edges of the conglomerate and the upper Chester. In the plane of the fault the rocks stand vertical, gradually flattening out to the north. The edges of the rocks just south of the fault have been only slightly deflected and bent downward to the fault plane.

The Whitethorn fault at the eastern edge of the Dawson Springs quadrangle has changed to a sharp anticline, the strata dipping at high angles to the north and to the south from the crest. Farther west in the region of Whitethorn Creek, it is a normal fault with the down-throw on the north. Between Tradewater river and Sandlick Creek it loses its identity, but appears again at Concord Church. There is a slight displacement in the north-south road  $\frac{3}{4}$  of a mile east of the western boundary of the quadrangle in line of the Whitethorn fault, but it cannot be traced continuously from there to Concord church.

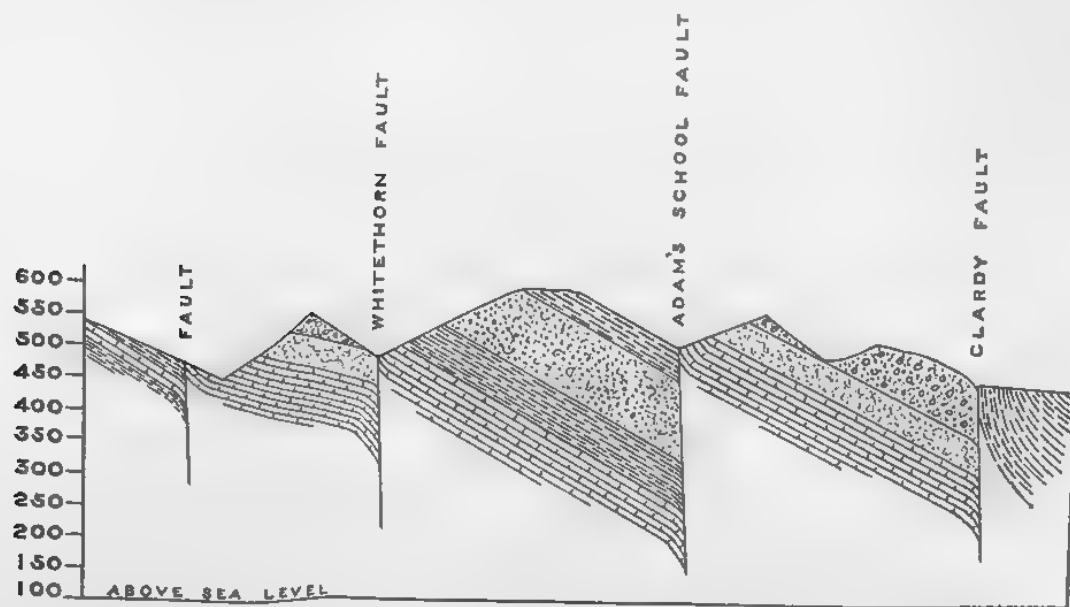


Figure 5.  
Cross section in faulted zone, on line C-D.  
Dawson Springs Sheet.  
Horizontal Scale—1 inch=2,000 feet.

There are two faults with considerable displacement south of the Whitethorn fault, one just west and the other just east of Tradewater River. The lateral extent of each is apparently about one mile in length. East of Tradewater the amount of displacement is between 80 and 100 feet with perhaps more in the one between Tradewater and Sandlick Creeks. A north-south cross section of the faults in the region of Adams schoolhouse is shown in figure 5.

The Claxton fault is named from the place by that name located one mile west of the western border of the Dawson Springs quadrangle. In the region of Claxton the strata on the north limb are affected for more than a mile north of the fault. The fault dip varies from about 90 degrees in the fault plane to about 5 degrees at Claxton. The fault one mile southwest of Claxton is a sharp fold which has been compressed to the point of breaking and the fold entirely closed. The rocks dip both ways from the crest.

To the east the fault assumes the nature of a normal fault with the down-throw on the north. The fault has a trend south 80 to 85 degrees east. From Claxton to Piny Creek the axis plunges rapidly eastward bringing the basal member of the Pennsylvanian down to the level of Piny Creek. From Piny Creek to near the crest of the ridge one mile east, the base of the Pennsylvanian rises about 150 feet, showing a rapid westward plunging of the axis in that region. From the dividing ridge east of Piny Creek to the southeast the Claxton fault loses its identity as a single fault and assumes an echelon or step-like structure and intersects the Adams school and Whitethorn faults at Concord church.

A fault with a displacement of more than 250 feet at Montgomery Creek, a short distance north of Ruth, passes south 75 degrees east near J. B. Haile's house on Piny Creek and is shown on the map as the Haile fault. The down-throw is on the north. From Mr. Haile's house the fault plunges eastward bringing down younger Pennsylvanian shales to the surface in the region of Franklin's store. At the latter place it has lost much of its identity as a fault and apparently fades out to the southeast before the Clardy fault is reached.

The Ruth fault, which is between the Claxton and the Haile faults, is a normal fault with a trend of about south 72 degrees east. West of Piny Creek the down-throw is on the north. East of Piny Creek the axis plunges eastward and merges into a well-defined syncline, which is discernible in the rocks on the Sandlick road, one-half mile west of Clifty Creek. From this place eastward it gradually loses its identity.

At a point a little more than one-half mile west of south of Mt. Hebron schoolhouse is a fault with a trend of south 55 degrees east, with a down-throw on the south. The amount of displacement is approximately 200 feet. At the crest of the ridge, one-half mile east of Montgomery creek, the base of the Pennsylvanian conglomerate, just north of the fault, occurs at an elevation of 590 feet. The top of the pebble-bearing rock just south of the fault occurs on the hillside at more than 100 feet lower elevation. North of the fault the northeast dip continues to the Norton school fault. The base of the Pennsylvanian, which is at an elevation of 590 feet just north of the fault on the ridge east of Montgomery Creek, disappears below the bottom of this stream two miles southwest of Dawson Springs.

A striking feature of the faulting in the southern part of the quadrangle is the direction of the fault planes. The faults in the western half of the quadrangle have a general southeast trend of south 75 to 80 degrees east. Near the center of the quadrangle in the faulted zone the trend of the fault planes changes to north 80 to 85 degrees east. East of Crofton there is a still greater variation to the north. The amount of displacement is greatest near the western and eastern edges of the quadrangle. In the region where the direction of the faults changes from northwest to northeast the amount of displacement is at a minimum.

About half way between the southern and northern faulted districts is a fault shown on the map as the Martin's Chapel fault. This fault was seen at only one place, viz., in a small branch three-fourths of a mile northwest of Martin's Chapel. The fault at that place has a trend of north 80 degrees east with the down-throw on the north. The rocks within a short distance of the break, are standing at an angle of 30 degrees.

The faults in the northern part of the quadrangle belong entirely to the normal and block type of faulting. In the southern district the strata are, in most places, greatly disturbed by crushing, brecciation and steep dips which may extend for a mile or more from the fault plane. In the northern district the fault plane is more generally clear cut and a few feet from the fault the strata assume their normal dip. The only variation from this rule in the northern district is in the region of Saint Charles and Daniel Boone. North of Saint Charles where faults have been encountered in coal mines the greatest inconvenience incurred has been in getting from one level to the other.

The general trend of the fault planes of the northern district varies from north 80 to 85 degrees east. A large number of these faults can be traced by actual displacement in the surface rocks across the quadrangle, and for some distance beyond its eastern and western borders.

The width of the faulted zone from north to south is two and one half to three miles. The southernmost fault, which is known as the Norton School fault, marks the southern limit of Nos. 9 and 11 coals in this quadrangle. The Bishop fault marks the northern limit of these coals from a point one mile south of Charleston eastward to within two and one-half miles of the eastern margin of the quadrangle. This fault apparently fades out before reaching the eastern edge of the quadrangle.

The area included in the fault zone consists of a block two and one-half to three miles wide which has been faulted down relative to the territory north and south of the faulted zone. The main block is cut up into smaller blocks by faults approximately parallel to those on the north and south borders. The nature of the faulting is shown in the cross section on line A-B (See Fig 4) which is approximately at right angles to the line of faulting.

The Norton School fault forms the southern boundary of the northern fault zone. It has a trend of north 82 degrees east with the down-throw on the north. It is traceable by displacement in the rocks and strong dips from Daniel Boone westward to the crest of the river hills, one mile east of Tradewater River. From there

westward the fault loses its identity. East of Daniel Boone it merges into a low fold which appears in the railroad cut one mile south of Nortonville.

The amount of displacement of the Norton School fault is not known. It is greatest in the region of Daniel Boone where, in the eastern edge of town, No. 11 coal is about 130 feet below the surface. No. 11 coal does not occur on the crest of the hill just south of the fault where the elevation is 120 feet higher than the surface at Daniel Boone. The displacement is, therefore, at least 250 feet. On the south side of the fault south of Saint Charles is an outcrop of limestone which appears to be the limestone 30 to 45 feet above the Dawson Springs coal. A short distance north of the fault No. 8-b coal outcrops. Upon this hypothesis the amount of displacement at that place would be about 200 feet and becomes less to the west.

The Dawson Springs fault has the greatest lateral extent of any single fault of the quadrangle. It was traced from a point four miles west of Dawson Springs, across the Dawson Springs quadrangle and beyond to Nortonville, three and one-half miles east of Daniel Boone. From the western margin of the quadrangle it plunges rapidly to Dawson Springs. In this locality the down-throw is on the north. From south of Saint Charles to Daniel Boone the fault plunges eastward and perhaps continues to Nortonville where No. 11 coal, just north of the fault, is more than 200 feet below the surface.

There is some doubt as to which is the down-throw side of this fault in the region between Saint Charles and Nortonville and since the question has an economic feature it deserves further discussion. If the down-throw is on the north side the region between Saint Charles and Daniel Boone contains Nos. 11 and 9 coals below the surface. If the down-throw is on the south side the region doubtless does not contain these coals. The outcrop of No. 11 coal, one mile west of Saint Charles, with an eastward dip, would seem to indicate that this coal continues under surface to the eastern margin of the quadrangle. The presence of coal 8-b in the region south and east of Saint Charles, in the Saint Charles block, precludes the possibility of coal 11 extending in this block east of Saint Charles.

However, No. 11 coal at Nortonville occurs in this block at a depth of more than 200 feet below the surface. There are, therefore, doubtless some cross faults in the block, one near St. Charles and another between Daniel Boone and Nortonville, dropping No. 11 coal down at either end and leaving older rocks at the surface in the center.

The Saint Charles fault passes through the northern edge of the town by that name. The displacement of the strata is very pronounced from Cane Run to the eastern edge of the quadrangle and is known to continue as far east as Nortonville. At the latter place this fault was encountered in driving the main north entry in the mine of the Norton Coal Company. On the north side of this fault No. 9 coal was found 40 feet higher than No. 11 coal on the south side. The amount of vertical displacement at Nortonville is about 125 feet. The amount of displacement, one mile west of Saint Charles is about 175 feet, as shown by the difference in the elevations of No. 11 coal in Dozier Hill and at the Woodruff outcrop one mile west of Saint Charles. At the latter place the south side is the down-throw side. Between Saint Charles and the eastern edge of the quadrangle coals 9 and 11 in the Saint Charles block, have been cut out by a cross fault somewhere near Saint Charles.

Between the eastern margin of the quadrangle and Nortonville is another cross fault which brings No. 11 coal 200 feet below the surface in the Nortonville mine or else there is a strong eastward dip from near the eastern margin of the Dawson Springs quadrangle to Nortonville. The coal in the Nortonville mine shows a westward dip from the shaft.

The Saint Charles fault apparently dies out a short distance west of Cane Run and is not seen farther west. The direction of the fault is north 85 degrees east.

The Crabtree-Dozier Hill fault is traceable from a point one-half mile north of White's schoolhouse, near the western margin of the Dawson Springs quadrangle, north 80 degrees east to Crabtree, old Carbondale mine, and Dozier Hill. The down-throw is on the north. In the vicinity of the old Carbondale mine, one mile east of Crabtree, the displacement is about 70 feet, and cuts off No. 9 coal to the south. The amount of displacement in

the old Saint Charles mine in Dozier Hill is reported to be 17 feet. From Dozier Hill to the eastern edge of the quadrangle the displacement apparently becomes less. An eastward extension of this fault passes just south of the Oak Hill mine, two and one-half miles east of the eastern boundary of the Dawson Springs quadrangle, where a throw of 200 feet on the south side is reported.\*

Between the Crabtree-Dozier Hill fault and Bishop fault are a number of faults from a few inches to about 50 feet displacement with the down-throw of each on the north. Two of these faults are shown on the map. These faults are most pronounced in the western half of the quadrangle, but fade out entirely before reaching Carbondale. These faults are approximately parallel and have a general trend of about north 84 degrees east.

The most northern fault shown on the Dawson Springs quadrangle is here called Bishop, it passing just north of the old Bishop mine. It has a general trend of north 85 degrees east with the down-throw on the south and delimits coals 9 and 11, on the north, as shown on the map. On the headwaters of Lick Creek No. 9 coal south of the fault is on a level with the Dawson Springs or Charleston coal north of the fault giving a throw on the south of about 276 feet. The amount of displacement north of Fox Run mine is 108 feet and decreases eastward.

### MINERAL RESOURCES.

Coal is the principal mineral product of the Dawson Springs quadrangle. Coals 9 and 11 occupy about eleven square miles in the northeast part of the quadrangle. The Dawson Springs-Empire coal underlies nearly two-thirds of the quadrangle. Shales and clays, of which the supply is inexhaustible, come next in importance with sandstones for building purposes and glass making, and limestone for road building, lime and other purposes for which limestone is used.

The following analyses made at various times in the laboratory of the Kentucky Geological Survey show the

\*L. C. Glenn Bull. 17, Ky. Geol. Survey, page 73.

nature of No. 9 coal at the three largest mines of this quadrangle.\*

In efficiency the No. 9 coal of this quadrangle ranks with the best coals of Illinois from the same seam. While the fixed carbon in air dried samples falls 1 to 2 per cent below that found in the Illinois coals, the volatile combustible matter, on the average, is higher and gives about the same efficiency, as expressed in British thermal units.

#### Analysis of air-dried samples.

	Per cent	
	(1)	(2)
Moisture .....	5.58	4.30
Volatile combustible matter .....	37.71	38.87
Fixed carbon .....	47.52	50.18
Ash .....	9.19	6.65
Total .....	100.00	100.00
Phosphorus .....	trace	
Sulphur .....	3.88	3.21
Coke .....	56.71	56.83
Specific gravity .....	1.34	
Color of ash .....	lilac	
Character of coke .....	porous	brittle
B. T. U. ....	12,605	

(1) No. 9 coal from Carbondale mine.

(2) No. 9 coal from Crabtree mine.

#### Analysis of No. 9 coal, Saint Charles mine.

##### Analysis of air-dried sample.

	Per cent
Specific gravity .....	1.322
Hydroscopic moisture .....	3.20
Volatile combustible matter .....	35.90
Coke .....	60.90
Total .....	100.00
Total volatile matter .....	39.10
Carbon in coke .....	54.00
Ash .....	6.90
Total .....	100.00
Character of coke .....	Light spongy
Color of ash .....	Light lilac gray
Percentage of sulphur .....	2.759

\*For additional analyses see analyses of Western Kentucky Coals, this volume.

## SHALES.

The Pennsylvanian series contain thick beds of aluminous shales suitable for at least the common grades of brick, sewer pipe, paving brick, drain tile and roofing tile.

At present the most accessible and therefore the most valuable deposits of shales are those which lie between the Dawson Springs and No. 11 coals, and a still thicker bed which lies close above No. 12 coal. These shale deposits are found in the region of Saint Charles and in the hills just east of Dawson Springs. The shale beds are persistent except where interrupted by faulting.

No tests have been made of these shales, but tests from similar deposits would indicate that these could at least be used for the purposes above given.

## SANDSTONES.

Good building sandstone is abundant in every quarter of the Dawson Springs quadrangle. A large amount of the sandstone of this region is hard and composed chiefly of silica, but it is used only locally for rough masonry. The purest beds of sandstone would be suitable for glass making. Some of the coarser sandstones could be crushed for building sand.

## LIMESTONES.

The limestones that occur at the surface in beds of sufficient thickness for commercial purposes occur in the southern part of the quadrangle. Where they appear at the surface they have been used locally for road ballast.

The limestones of the Mississippian occur in beds of 10 to 50 feet or more in thickness. In many of the beds the percentage of lime is high and, on burning, would make a desirable lime. The purer beds could be crushed and used for agricultural lime. Its white oolitic character renders it a desirable building stone. Near Princeton, about five miles west of the western border of the Dawson Springs quadrangle, a limestone, similar to that which forms the surface in the southwestern corner of this quadrangle, has, for a number of years, been crushed for railroad ballast.

## OIL AND GAS.

Three oil wells, the deepest of which is reported to be 1,000 feet, were drilled near the mouth of Sandlick Creek a number of years ago. The largest well is reported to have produced a small amount of oil a day until it was shot with forty-two quarts of nitroglycerine, when the oil ceased to flow. The water now stands within two feet of the surface and there is considerable evidence of oil around the top of the well. In one of the smaller wells, said to be 300 feet deep, there is still a small amount of oil which rises on the water and runs off down the branch. The water stands within twelve inches of the surface and periodically overflows.

These wells are located a few feet south of the Clardy fault and are about one mile north of the White-thorn fault, a very undesirable location for oil wells. The wells are located in a faulted zone where the rocks are badly broken and stand at high angles. A much more desirable location for a test well would have been on the crest of the low fold one mile south of Collins bridge, but even there the possibility for getting oil in paying quantities is meagre.

Could a fold or reversed dip be found in the region south of the faulted zones, there would be a possibility of getting oil in the Devonian or Niagaran limestones, but, so far as the writer was able to determine, the rocks dip uniformly to the north. In the remainder of the quadrangle the strata are so badly broken up by faults that any attempt to find oil or gas will likely prove a failure.

## WATER.

Water for domestic purposes is usually found in abundance in shallow dug or drilled wells. In many localities the water is impregnated with more or less salts of iron, magnesia and other minerals.

At Dawson Springs are a number of shallow wells which supply a wide range of mineral waters. The wells are all shallow, 15 to 40 feet deep, the source of the water being a bed of aluminous shales or sandstone. Dawson is located on an east-west fault into which the mineral ingredients found in the waters have been carried by both ascending and surface waters. This is shown by the fact

that the mineral wells are confined to a narrow east-west belt of low land extending through the town. South of the main fault, at the city water works plant, the water is an exceptionally pure soft water. The following are some of the many analyses that have been made of the leading mineral waters. Some of the waters contain a large percentage of iron carbonate, in others the principal ingredients are calcium, sodium and magnesium sulphate.

Analyses of mineral waters.  
Arcadia Well No. 1.

	Grains per U. S. gallon
Bicarbonate of iron.....	2.281
Silicates and insoluble matter.....	2.200
Chloride of magnesium.....	0.482
Carbonate of magnesium.....	0.707
Chloride of sodium.....	0.501
Carbonate of lime.....	5.701
Alkalies .....	6.114

Arcadia Well No. 2.

	Grains per U. S. gallon
Sodium chloride .....	110.0
Potassium chloride .....	6.0
Sodium nitrate .....	3.36
Sodium sulphate .....	43.0
Magnesium sulphate .....	282.1
Calcium carbonate .....	7.5
Calcium sulphate .....	289.2
Bicarbonate of iron.....	627.36
Sulphate of alumina .....	14.4
Alumina .....	10.0
Silica .....	38.0
Total solids .....	1730.92

Arcadia Well No. 3.

	Grains per U. S. gallon
Sodium chloride .....	110.00
Potassium chloride .....	6.00
Lithium chloride .....	0.00
Sodium nitrate .....	3.36
Sodium sulphate .....	43.00
Magnesium sulphate .....	282.10

Calcium carbonate .....	7.50
Calcium sulphate .....	289.20
Bicarbonate of iron .....	627.36
Sulphate of alumina .....	14.40
Alumina .....	10.00
Silica .....	38.00
Total solids .....	1730.92

Arcadia Well No. 4.

	Grains per U. S. gallon
Sodium chloride .....	232.5
Potassium chloride .....	5.0
Lithium chloride .....	23.1
Sodium nitrate .....	7.5
Sodium sulphate .....	1017.4
Magnesium carbonate .....	396.0
Magnesium sulphate .....	2260.0
Calcium sulphate .....	2057.0
Iron .....	0.3
Alumina .....	7.7
Silicates .....	20.0
Total solids .....	6026.8

Hamby Well.

	Grains per U. S. gallon
Silicic acid .....	1.6472
Bicarbonate of iron .....	5.1330
Oxide of aluminum .....	0.1856
Calcium sulphate .....	56.4282
Sodium chloride .....	5.0944
Magnesium sulphate .....	50.6688
Bicarbonate of calcium .....	11.4376
Sodium sulphate .....	41.1800
Magnesium bi-carbonate .....	43.4130
Sodium phosphate .....	0.8932
Potassium sulphate .....	6.6526
Manganese bi-carbonate .....	2.9870
Bromides .....	trace
Free carbonic acid gas .....	5.9740
Calcium nitrate .....	0.3016
Lithium bi-carbonate .....	trace
Organic matter .....	none
Temperature of water at well.....	58 degrees
Total solids .....	235.9962

## SECOND ANNUAL REPORT

## Redden Well.

	Grains per U. S. gallon
Ferrous carbonate.....	0.03
Calcium carbonate .....	26.17
Magnesium carbonate .....	0.77
Strontium carbonate .....	trace
Calcium sulphate .....	76.31
Magnesium sulphate .....	162.98
Potassium sulphate .....	1.59
Sodium sulphate .....	32.85
Lithium sulphate .....	trace
Sodium chloride .....	11.88
Silica .....	1.25
Total solids .....	313.83
Total solids at 100 degrees C. ....	340.47
Ignited solids .....	291.79

## Patterson Well No. 1.

	Grams per liter	Grains per gallon
Ferrous carbonate .....	.0188	1.10
Manganous carbonate .....	.0032	.19
Calcium carbonate .....	.3900	22.74
Calcium sulphate .....	.8220	47.92
Magnesium sulphate .....	1.4554	84.85
Sodium sulphate .....	.1822	10.62
Sodium chloride .....	.1140	6.64
Potassium and lithium.....	marked traces	marked traces
Strontium .....	trace	trace
Total .....	2.9856	174.06
Total solids at 100° C. ....	3.1850	185.69
Ignited solids .....	2.8850	168.20

## Patterson Well No. 2.

	Grams per liter	Grains per gallon
Ferrous carbonate .....	.0332	1.94
Manganous carbonate .....	.0066	.38
Calcium carbonate .....	.5300	30.90
Calcium sulphate .....	1.1764	68.58
Magnesium sulphate .....	2.3895	139.31
Sodium sulphate .....	.5445	31.74

## KENTUCKY GEOLOGICAL SURVEY

Sodium chloride .....	.1862	10.86
Potassium and lithium.....	marked traces	marked traces
Strontium .....	trace	trace
Total .....	4.8664	283.71
Total solids at 100° C.....	6.1630	359.30
Ignited solids .....	4.6150	269.05

## Phillips' Well.

	Grains per U. S. gallon
Alumina .....	2.42
Iron bicarbonate .....	0.36
Calcium bicarbonate .....	3.31
Magnesium sulphate .....	358.36
Potassium bicarbonate .....	16.05
Potassium chloride .....	11.14
Silica .....	65.47
Sodium sulphate .....	51.72
Sodium chloride .....	0.30
Total .....	509.13

## Summit House Well.

## Parts in 100 parts of water.

Carbonate of iron .....	7.680
Carbonate of lime .....	0.566
Carbonate of magnesia .....	0.370
Chloride of calcium .....	0.327
Chloride of magnesium .....	0.059
Sulphate of magnesia .....	0.101
Chloride of sodium .....	0.220
Chloride of potassium .....	trace
Silica .....	0.300

## Ramsey's Magnesia Well.

	Grains per U. S. gallon
Ferrous carbonate .....	0.59
Calcium carbonate .....	1.28
Calcium sulphate .....	12.67
Magnesium sulphate .....	7.12
Potassium chloride .....	1.25
Sodium chloride .....	15.50
Sodium bicarbonate .....	trace
Silica .....	2.33
Total .....	40.74

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**GEOLOGY AND ECONOMIC PRODUCTS OF THE  
EARLINGTON QUADRANGLE**

BY

**A. F. CRIDER**

1914

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## LETTER OF SUBMITTAL.

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Mr. J. B. Hoeing,  
State Geologist.

Dear Sir:

I herewith submit a report on the Geology and Economic Products of the Earlington Quadrangle, including parts of Hopkins and Webster Counties. The report is the result of a detailed work of a portion of summer of 1913.

Very respectfully,

A. F. CRIDER,  
Assistant Geologist.

Frankfort, Ky.,

February 1, 1914.

## TABLE OF CONTENTS.

	Page
Introduction .....	75
Location .....	76
Culture .....	76
Topography .....	78
Dissected uplands .....	78
Nébo lowlands .....	78
Stream bottoms .....	79
Relief .....	79
Drainage .....	80
General Geology .....	81
Previous geological work .....	81
Stratigraphy .....	81
General sections .....	82
Structure .....	87
Webster-McLean syncline .....	87
Folds .....	89
Faults .....	90
Richland fault .....	90
Effects of the Richland fault on the workable coals.....	91
Stony Point Church fault.....	91
Minor faults .....	92
Unconformities .....	93
Economic Geology ....	94
Coals .....	94
Maximum depth of No. 9 coal .....	96
Dip of the coals .....	96
Quality of the coals .....	97
Coal analyses .....	97
Shale .....	98
Fire clay .....	98
Building stone .....	99
Sand .....	99
Oil and Gas .....	99
Coals below No. 9 .....	100
Number 9 coal .....	104
Outliers .....	105
Individual mines .....	105
Luton mine .....	107
Thomas Wanless mine .....	107
Rose Creek Coal Company .....	108
Polk Lutz mine .....	108
Peter Howton mine .....	109

## CONTENTS—Continued.

Economic Geology—Number 9 coal—Individual mines—	Page
Beulah district .....	110
Silent Run district .....	110
Hanson School district .....	112
Earlington district .....	112
Number 11 coal .....	115
Providence district .....	116
Coiltown district .....	119
Beulah district .....	122
Hanson School district .....	122
Richland district .....	123
Earlington district .....	124
Madisonville district .....	126
Number 12 coal .....	128
Nebo coal .....	129
Coals above the Nebo coal .....	132
Madisonville limestone .....	132
Bore and shaft records .....	135

## GEOLOGY AND ECONOMIC PRODUCTS OF THE EARLINGTON QUADRANGLE.

### INTRODUCTION.

The following report comprises the results of a study of the general geologic and commercial features of the Earlington quadrangle, in so far as it relates to the mineral wealth of the district. The outcrop lines of numbers 9 and 11 coals are given on a map accompanying the report as a guide to those who are interested in the further development of the coals of this region. With these coals as a basis around which the present mining interest centers, the relative distribution of the less important coals is also given.

On a following page is a generalized section of the strata as applies to this particular area. It was made from numerous well records and actual measurements of exposed sections in various parts of the quadrangle. Where there were ten, twelve or more records, as the case may be, penetrating the same rocks in different parts of the area, a general average of each structure was taken. With the large number of records, at the disposal of the writer, of the rocks below the Madisonville limestone, it is thought that the generalized section of the various strata from the base of the Pennsylvanian up to and including the Madisonville limestone can be relied upon as fairly representative.

For the want of reliable well records in this area there is more uncertainty as to the relation and thickness of the rocks above the Madisonville limestone. However, the present writer has found the section of the Pennsylvanian above the Madisonville limestone exposed in the area under discussion to be considerably greater than the same interval in the Madisonville quadrangle as given in Bulletin No. 19.\*

\*Bulletin No. 19, Kentucky Geological Survey, page 71.

The present writer desires to make acknowledgments to the former geologists who have worked in the same field, and whose reports have been freely consulted in the preparation of this report. They consist of the four reports of Doctor David Dale Owen, Bulletin No. 17, and an unpublished report of Webster County, by L. C. Glenn, and the various reports on the western coal-field by C. J. Norwood.

The writer is greatly indebted to the various coal companies of this district for test well records, permission to examine the mines and other courtesies shown. The dip of the coal beds and in some instances the outcrop line of No. 9 and No. 11 coals were made possible largely by the use of the numerous records placed at the disposal of the writer. The St. Bernard Mining Company, of Earlington, deserves special mention for copies of their records, which cover an extensive area in the region under discussion.

#### LOCATION.

The Earlington quadrangle is located in the southwestern portion of the Western Kentucky coal field. It includes 238 square miles, the major portion of which is in western Hopkins County, with approximately 55 square miles in southern Webster county.

#### CULTURE.

Agriculture and mining are the principal occupations of the people. The entire area, except in the undrained lowlands, is admirably adapted to the production of dark tobacco for which western Kentucky is famed. Corn, wheat, oats, timothy and red top for hay are also grown in larger quantities than are necessary for home consumption. Cattle and other stock are grown for market. On the whole the farmers of this district are more prosperous than those of most counties in Western Kentucky.

Along some of the larger streams draining into Tradewater are still to be found several thousand acres of undrained bottom land which awaits the co-operation of the landowners to effect a system of drainage which will make this the most productive area of the quad-

rangle. This will perhaps not be accomplished until a State law is enacted whereby the landowners holding a majority of the undrained land are permitted to organize a drainage district and assess the land for drainage according to the benefits derived therefrom.

The transportation facilities consist of the Evansville branch of the Louisville and Nashville railroad, which extends in a north-south direction, near the eastern border of the quadrangle, and connects Slaughtersville, Madisonville and Earlington, all or parts of which towns are in this area. The Morganfield branch of the same road crosses the quadrangle in an east-west direction near the center. The Providence-Dixon branch of the Illinois Central railroad crosses the extreme northwest corner of the quadrangle.

About four-fifths of the population of the district are within five miles of a railroad line. The outcrop line of the No. 9 coal, with the exception of a few outliers of this coal in the southwestern part of the area, can be reached from a railroad at a distance ranging from three to six miles.

Earlington, in the extreme southeastern part, is the largest town lying wholly within the quadrangle and is the center of a large coal mining industry. It is the home office of the St. Bernard Mining Company, which has five large coal mines and fifty-two coke ovens located in the town. Madisonville, the county seat of Hopkins County, lies three miles to the north. Part of it lies in the Earlington and part in the Madisonville quadrangle. It likewise is the center of a large coal mining trade and is adjacent to a good farming district. Slaughtersville, in the extreme northeastern corner, is the largest town in the northern half of the area. Lisman, in the northwestern corner, is a small village in the midst of a very productive farming belt. Nebo and Manitou, two small towns near the center of the quadrangle, have long been noted for the production of dark tobacco. At one time Nebo, with the single exception of Louisville, had the distinction of being the largest loose leaf, dark tobacco market in the United States. However, it has long since lost that distinction and the last large tobacco warehouse was burned during the year 1913. Coiltown and Circle City are two small mining towns three miles south of

Nebo. Providence, an old town with new life, lies just off the sheet to the west. In fact, a small part of the town is shown in the Earlington quadrangle. The awakened life of Providence is due, in a large measure, to the increased development of the coal mining industry within and near its borders.

### TOPOGRAPHY.

The surface of the region may be divided into dissected uplands, Nebo lowlands and stream bottoms.

#### DISSECTED UPLANDS.

The dissected uplands comprise about one-half of the territory lying in the northern and southern parts of this quadrangle. The surface of the entire area is the result of the unequal wearing of the surface rocks by water and other agents of erosion. Valleys and stream channels were not made for the streams, but by them. Where there is a large percentage of hard rocks like close-grained sandstones and limestones, the streams cut their channels very slowly and the surface of such a region wears away unequally, giving rise to a dissected type of topography. This is well illustrated by the nature of the rocks in the northern and southern parts of the area treated in this report. The underlying rocks in each of the two districts are hard sandstones alternating with shales. Shales wear away rapidly and uniformly where not protected by overlying harder rocks, but where they are capped by hard limestones, steep hills and often narrow valleys result. The steepness of the slopes and the width of the valleys depend on the amount, position and structure of the hard and soft rocks and the gradient of the streams.

#### NEBO LOWLANDS.

The Nebo lowlands include a belt of level to gently rolling land three to six miles wide extending from Lisman across the quadrangle in a southeast direction and merge into the hills between Madisonville and Earlington. They contain some of the best farming lands of the region. The towns of Nebo and Manitou are in the heart

of this area. The rocks underlying this area are composed chiefly of soft shales with thin strata of soft argillaceous limestones and thin coals. These uniform soft shales have offered less resistance to the agents of erosion than the harder sandstones to the north and south where the tops of the highest hills rise from 150 to 200 feet above the general level of the Nebo lowlands.

#### STREAM BOTTOMS.

The larger streams of the quadrangle have broad flat bottoms which extend far up toward their sources. In times of excessive high water, like the Spring of 1913, backwater from Tradewater comes up Clear and Weirs Creeks to an elevation of 365 feet. The materials of these creek bottoms are composed of stream alluvium which is 100 or more feet thick in the larger streams, and gradually thins to the heads of the streams.

The thick deposits of stream alluvium indicate a period of uplift and rapid erosion in which the streams were flowing in valleys 100 feet below their present position. The period of rapid down-cutting was followed by a widespread subsidence of the land. It was during the latter period that the great amount of stream detritus was deposited in the stream bottoms. At the present time the streams appear to be aggrading rather than filling up their bottoms.

#### RELIEF.

The total amount of relief in the area under discussion is a little more than 325 feet. The lowest land is that found on Clear Creek at the extreme western edge of the sheet, where the elevation above sea level is about 355 feet. The highest point is found in the extreme southeastern corner, where the elevation rises to 680 feet above sea level.

The general elevation of the crest of the divide between the waters of Green and Tradewater Rivers is approximately 575 feet above sea level, the highest hills rising 25 feet higher. The streams on either side of this divide and within half a mile of their source, have cut their channels down into the sandstones and shales to a depth of about 150 feet. From this point to where they

enter Clear Creek, a distance varying from six to eight miles on a direct line, the streams have a total fall of approximately 75 feet, or nine to twelve feet to the mile.

The Nebo lowlands have a general elevation of 420 feet above sea level, with a total amount of relief of only eighty feet, and this in only one or two places. The more general relief is forty to fifty feet.

In the region south of Clear Creek, the crests of the highest hills in the eastern part of the quadrangle rise to an elevation of 600 feet or more and gradually become lower to the west as Tradewater River is approached. A large part of the area south of Clear Creek, except the first and second bottoms of the streams, is rough; especially is this true of the region where No. 9 and No. 11 coals outcrop.

#### DRAINAGE.

The area treated in this report contains no large streams. Tradewater, which flows in a general northward direction just west of this area, receives the drainage of more than two-thirds of the entire district. Clear Creek is the main trunk stream of the quadrangle. It flows in a general northwest direction just south of and parallel to the Nebo lowlands. Weirs, Pond and Greasy Creeks enter it from the north. The sandstone ridge in which the latter mentioned streams have their source, forms the divide between the waters of Green and Tradewater Rivers. Silent Run, Richland and Sugar Creeks enter Clear Creek from the south. Lick Creek drains the southwestern part of the area. Slover Creek, whose waters also enter Tradewater River, drains the northwestern corner of the quadrangle.

The two branches of Deer Creek, whose waters find their way into Green River, drain the central and northeastern parts of the quadrangle, north of the Tradewater-Green River divide. These streams, like the ones south of the divide, have broad valleys in their middle and lower stretches, with extensive second bottoms which are above the overflow of the present streams. The broad area of these level lands is apparently due to thick beds of shale underlying the soft sandstones so prevalent in the northern part of the area. The sandstone here has been carried away by erosion and the work of the

streams on the softer underlying shales has been more rapid, resulting in the broadening of the valleys.

In the upper stretches of the main streams, and likewise of the small tributaries, the process of down-cutting is still confined to the sandstones. And here, as may be expected, the valleys are narrow and the slopes steep, giving rise to a rough topography.

#### GENERAL GEOLOGY.

##### PREVIOUS GEOLOGICAL WORK.

The first geological work in Western Kentucky was inaugurated by Owen in 1854 and continued to 1859. The results of the work done by Owen and his assistants are found in volumes one to four inclusive, Old Series, of the Kentucky Geological Survey. Considerable amount of detail, including a general section of the Western Kentucky coal field, was given. The principal reference to the area included in the present report was that made by Lyon in volume two, mentioned above.

Additional data bearing on this area was later given by Norwood in volume four, New Series, Kentucky Geological Survey, in 1878, and in the Tenth Annual Report of the Inspector of Mines of Kentucky, 1893.

The above work has been supplemented in more recent years by L. C. Glenn, in Bulletin No. 17, Kentucky Geological Survey, 1912, and an unpublished report by the same author. The latter report covers Webster County, a small area of which is included in the present report.

#### STRATIGRAPHY.

All the rocks outcropping at the surface in the area under discussion are of sedimentary origin and belong to the Pennsylvanian series. The full thickness of the rocks exposed measures about 1,000 feet. The lowest exposed rocks are those which occur a little below the chert bed (number 76 of the general section) which underlies a coarse-grained sandstone, the probable equivalent of Owen's Curlew sandstone. The highest stratified rocks, as shown in the general section, are 757 feet above the top of number twelve coal. All the workable coals of Western Kentucky, with the exception of the

Bell and the Dawson Springs coals, are included in the strata exposed in the Earlington quadrangle.

Strata older than the Pennsylvanian do not outcrop in the area under discussion. They form the surface of the country to the southwest and underlie the Pennsylvanian in this quadrangle. By the help of well records and surface outcrops in this and adjoining quadrangles we are enabled to construct a general section from the base of the Pennsylvanian to the highest strata of the Pennsylvanian series exposed in this quadrangle.

A deep well at Earlington was begun at about the horizon of number nine coal and ended at a depth of 1,316 feet. If the interpretation of the log is correct, this well entered the top of the Chester rocks at a depth of 801. It will be seen, however, that the distance from the number nine coal to the base of the Pennsylvanian in the Earlington well, is 100 feet greater than that given in the general section.

GENERAL SECTION.		Feet
1. Sandstone		10
2. Shale		20
3. Sandstone		7
4. Shale		2
5. Sandstone		1
6. Siliceous shale		7
7. Coal No. 15		1 — 6
8. Fire clay		5
9. Shale		14
10. Dixon sandstone		15
11. Coal		thin
12. Gray shale with thin sandstone		100
13. Black slate		5
14. Hard black shiny coal (may be No. 14)		3
15. Fire clay		1 — 6
16. Limestone		3
17. Gray shale		10
18. Shale interval, perhaps having one or two thin coals		155*

\*At bore hole No. 15 the base of the Madisonville L. S. is at 404 A. T. and in bore hole No. 14 it is at 193 A. T., giving a dip in  $2\frac{1}{2}$  miles of 211 feet or 84 feet per mile. Two miles N. E. of bore hole 14 the base of the Dixon S. S. is at 500 A. T. Allowing a dip of 84 feet per mile (which is probably a little too great owing to the flattening dip) the base of the Madisonville L. S. at the exposure of the Dixon S. S. would be 25 A. T. and the interval from the base of the L. S. to the base of the Dixon S. S. would be 475 feet. At this point there is exposed 122 feet below the S. S. the total thickness of the L. S. in bore hole 14 is 83 feet and of shales above the L. S., 115 feet.  $122+115+83=320$  and  $475-320=155$  feet of unaccounted shale interval.

	Feet
19. Shale	103
20. Shaly limestone	10
21. Shale	25
22. Limestone	6
23. Red shale	6
24. Limestone	3
25. Red shale	9
26. Limestone	4
27. Shale	14
28. Sandstone in places changing to shale	30
29. Shale	90
30. Coarse sandstone	40
31. Gray shale	10
32. Nebo coal	7
33. Shale	30
34. Sandstone, Anvil Rock	15
35. Coal, No. 12	4
36. Fire clay	2
37. Limestone	4
38. Gob	— 6
39. Coal, No. 11	6 — 6
40. Fire clay	3
41. Blue to gray shale	9
42. Sandstone	42
43. Blue to gray shale	26
44. Black slate	3
45. Coal, No. 9	5
46. Fire clay	3
47. Limestone not everywhere present	2
48. Shale	8
49. Sandstone	12
50. Shale	39
51. Black slate	4
52. Coal, No. 8-b	2
53. Fire clay	2
54. Limestone	3
55. Massive sandstone, becoming thin bedded above	15
56. Shale, containing plant impressions	10
57. Coal, No. 6 of Owen	3
58. Fire clay	3
59. Sandstone, micaceous	30
60. Shale	5
61. Coal	thin
62. Fire clay	12
63. Gray shale	12
64. Black shale	10
65. Coal	thin

	Feet
66. Fire clay .....	2
67. Shale .....	30
68. Sandstone .....	30
69. Shale .....	12
70. Limestone .....	3
71. Shale .....	30
72. Coal, Dawson and Empire .....	4
73. Fire clay .....	1
74. Shale .....	10
75. Sandstone .....	30
76. Chert .....	10
77. Gray clay and shale .....	40
78. Gray sandstone .....	40
79. Shale .....	6
80. Gray sandstone .....	12
81. Iron conglomerate .....	1
82. Hard siliceous shale .....	4
83. Black hard coal .....	1
84. Shaly sandstone .....	7
85. Shale .....	4
86. Thin coal .....	1
87. Iron ore band .....	thin
88. Shaly sandstone .....	6
89. Shale .....	6
90. Coal with shale parting .....	2
91. Shale .....	9
92. Iron stained sandstone .....	2
93. Shale .....	2
94. Coal (Bell coal) .....	thin
95. Iron stained sandstone .....	4
96. Shale .....	55
97. Sandstone .....	4
98. Shale .....	150
99. Sandstone, upper 10 inches ferruginous .....	10
100. Sandstone interbedded with equal amount of shale .....	20
101. Conglomeratic sandstone, base of Coal M. ....	105
102. Limestone .....	thin
	1580

The rocks of the Pennsylvanian outcropping in the Earlington quadrangle are shales, sandstones, limestones, clays and coals. Overlying these sedimentary rocks is an unconsolidated deposit of clay loam and loess, which covers the ridges and slopes in blanket form, concealing from view much of the stratified rocks.

Shales are the thickest and most numerous members of the series. They occur as soft argillaceous shales, or as hard arenaceous shales, and are usually known by drillers as "soapstone." The color, when fresh, may be black, blue or gray, and in some instances reddish. On exposure to the surface agencies they become of lighter color, the black and blue often assuming a chocolate tinge.

Shales that occur just above the roof of coals are generally dark, and for that reason are important criteria in both surface outcrops and in well records in locating coals. These black shales may be very hard and laminated, giving them the appearance and structure of slates. The black shales found above coals No. 8-b and No. 9 have many of the properties of black slate and are known to miners and drillers by that name.

Some shales contain more or less calcium carbonate, which in many places has collected into oblong, oval and spherical concretions, commonly known as "nigger heads." They are especially abundant in the black shales overlying No. 9 coal, and to a less extent in the black shales above No. 11 and in two of the lower coals.

Practically all coals are associated with shales. This fact has become so generally known that the uninitiated often think the presence of shales likewise indicates the presence of coal. Shales are of little value, in themselves, for the determination of geological horizons.

Sandstones of the Pennsylvanian are more varied than the shales. In some parts of the series they form the major part of the deposits while in others they are practically absent. They occur as massive sandstones, void of cross-bedding and stratification, or highly cross-bedded and with well marked lines of stratification. The greater part of the sandstones are soft, loosely cemented rock, like that found above No. 9 coal, and those nearer the top of the series. At a few horizons the sandstones are hard, fine-grained rock, which is very resistant to the action of the weathering agents and forms prominent scarps across the quadrangle and, in the absence of more trustworthy criteria, may be of value in determining geological horizons.

The color of the sandstones is generally gray to white, with impurities of iron oxide, clay and vegetable

matter which give a reddish brown, buff or dark color, depending on the proportion of the impurities.

Sandstones were formed in comparatively shallow water near the shore line and are subject to a greater change in character and thickness than other sedimentary rocks. While they are more trustworthy than shales as an aid in determining geological horizons, they are less valuable as such than limestones and coals.

Where a large amount of clay was mixed with the sand in the process of deposition, the resulting composite is called a "clayey or argillaceous sandstone." If the predominating material is clay with more or less sand the deposit is known as "arenaceous or sandy shale." The above terms are often used interchangeably, especially by well-drillers, and may be somewhat misleading.

Limestones form a comparatively small proportion of the stratified rocks of the Pennsylvanian, but on account of their persistency and resistance to the action of the weathering agents, they became excellent key rocks in the district for the determination of geological horizons. They are usually fine grained, non-crystalline in character, and are easily distinguished from the limestones of the Mississippian. The color is frequently dark blue to gray on fresh fractures and they weather to a reddish clay soil, which may aid in locating coals in the absence of the limestone. Marine fossils are present in most of the limestones of this area. In one or two horizons below No. 9 coal, the limestones carry a considerable amount of chert, which weathers out of the limestone in small fragments from the size of a marble to a man's head. The thickness of these limestones varies from a few inches to about twenty feet. The limestone above No. 11 coal and the Madisonville limestone are two of the most important key rocks of the district and will be discussed in connection with the coals.

Practically all coals rest on beds of under clay, which is generally known as "fire clay." The thickness of the underclays varies from a few inches to eight or ten feet. The color is a light gray with a greater or less amount of vegetable matter. The large amount of impurities found in the majority of the underclays precludes their use for plastic wares.

Coals form the chief economic mineral of the Earlinton quadrangle. They occur as from mere bands up to eight and even nine feet in thickness. The coals of this region are all of a bituminous nature. Occasionally a find of cannel coal is reported, but on closer examination the find proves to be a thin band of bituminous shale that has the resemblance of cannel coal. Block coals are likewise absent.

At present three coals, No. 9, No. 11, and the Nebo coal, are mined for shipment. The mines working the above mentioned coals are located in a northwest-southeast direction across the quadrangle, and near the center from north to south. The greater part of the wagon trade of people living in the Earlinton quadrangle is, therefore, in reach of these thick coals, and this makes the operation of the thinner and softer coals at present unprofitable.

#### STRUCTURE.

The Pennsylvanian rocks of this area, with the exception of the coals, were originally formed by sediment transported by the action of running water and deposited on a broad horizontal or slightly inclined bottom. The original horizontal position of the beds was later greatly modified by earth movements which bent the strata into broad troughs and arches with minor undulations. In some places the folding has been accompanied by faulting which results from bending of the strata to the point of breaking.

The conditions necessary to produce folding and faulting of the rocks are of interest to the scientific student but are not incident to the purpose of this report. However, the structure of the rocks as we now find them has a direct bearing on the mining of coals and other mineral products and deserves mention here.

#### WEBSTER-MCLEAN SYNCLINE.

The structure of the rocks of the northern part of the area here treated is a low, broad syncline with the main axis located north of the center and extending across the quadrangle in a generally northwest-southeast direction.

In an unpublished report of Webster County, Doctor L. C. Glenn calls the syncline the "Webster syncline." It extends from Webster county across the northern part of Hopkins County into McLean County and is here called the Webster-McLean syncline.

The axial portion of the syncline, according to Glenn, extends through the region of Luzon, Dixon and Mount Gilead schoolhouse, and continues in a southeastward direction. According to the present writer's observation, however, the main axis crosses the line of the Louisville and Nashville railroad between Slaughtersville and Hanson at a point about half-way between the two places. From Slaughtersville south for two and a half miles the rocks have a pronounced southward dip. In the second railroad cut, the rise to the north continuing beyond Slaughtersville; one mile south of Slaughtersville, the southward dip of the rocks is ten degrees. The strong dip continues about one mile farther south, where it is interrupted by a fault bearing N. 55 to 60 degrees east. South of the fault the dip flattens somewhat and is finally completely eliminated by other faults approximately parallel to the one given above. For a short distance south of the last fault seen the rocks are horizontal.

South of the main axis the strata rise first at low angles, which become greater as the outcrop of No. 9 coal is approached. The southward rise continues beyond the southern limit of the area described, the long limb of the syncline being on the south side. North of the main trough the rocks dip southward and stand at higher angles than they do south of the main axis. North of the main axis in the northwest part of Webster County, the northward rise of the strata is terminated abruptly by the Rough Creek fault which passes through Sebree and Tilden and continues westward through Webster and Union Counties to Shawneetown, Illinois. In the eastern part of Webster this syncline is separated from the Rough Creek fault by the Sebree anticline. Still farther east another smaller syncline seems to lie between the main syncline and the Rough Creek fault.

The main axis of the syncline is approximately at right angles to the dip of the rocks on either side. In the eastern part of the quadrangle the dip is slightly east of

north. In the extreme western edge of the area the dip is twenty-three degrees east of north. The highest rocks of the Pennsylvanian occur along the main trough of this Webster-McLean syncline.

The main structural features in the central and southern parts of the area here treated show the strata in the position of an extensive monocline with the dip to the north toward the Webster-McLean syncline. The general northward dip is interrupted at rare intervals by slight reverse dips, subsequently described, and by faults for short distances only. The northward dip is not everywhere uniform. In the region of the outcrop of No. 9 coal it varies from 60 to 120 feet to the mile, with a general average of 75 feet to the mile. The dip, as calculated by outcrops and test wells on Nos. 9 and 11 coals, is graphically shown on the accompanying plates.

In the southwestern part of the quadrangle, along the waters of Lick Creek, there is a slight southwest dip of the strata. This is shown in the rocks along Frazier Ridge and in the chert horizon west of Lick Creek.

What appears to be a south to southwest dip likewise occurs in the region between Silent Run and Richland Creeks, based on the elevation of No. 11 coal in various parts of the ridge. At a point three-fourths mile northeast of Henson schoolhouse No. 11 coal occurs at an elevation of 530 feet. At an old abandoned opening on the same coal one mile southeast of Henson schoolhouse the elevation of the coal is 455 feet. At a point one and one-fourth miles due south of Henson school the elevation of No. 11 coal is 425 feet, showing a south to southwest dip.

#### FOLDS.

The rocks of this region have been subjected to two forces which have bent the rocks into broad low arches and troughs. The primary or major folding has left the rocks dipping to the central basin, which has been described above as the Webster-McLean syncline. The dip of the rocks is toward the central basin with a strike at right angles to the dip or parallel to the crest and bottom of the folds. The smaller folds, whose crests and bottoms are approximately east and west, are rarely de-

tected except in coal mines, and even here they are small.

In addition to the primary folds are minor or secondary folds whose crests and bottoms are at right angles to the crest and bottoms of the primary folds. The dips of the rocks of the secondary folds are parallel to the strike of the primary folds or east and west. In like manner the strikes of the secondary folds are parallel to the dip of the primary folds or north and south.

In regions of close folds the above conditions give rise to complicated dips and strikes and often lead to error in working out the geology of such a region. Where faulting occurs parallel to the strike of the major folds, as is the case in the Earlington and the Dawson Springs quadrangles, there is a plunging of the axis of the faults which appear to fade out on the crests and in the troughs. This plunging of the axis is noticed in all the faults of this region.

#### FAULTS.

Rough Creek fault, the most pronounced disturbance of Western Kentucky, lies 6 to 8 miles north of the Earlington quadrangle. Immediately south of the main fault, in the vicinity of Sebree, the rocks have been folded into a sharp anticline or dome. The short limb of the anticline dips rapidly north to the fault. The long limb dips even more rapidly to the south for some distance, then more gently to the central trough of the Webster-McLean syncline, as described above.\*

**RICHLAND FAULT.**—In the southern third of the quadrangle is a large fault which crosses the area in a general direction of N. 75 degrees E. Richland is located on the fault and it is here called the Richland fault. The western extension passes one-half mile north of Kirkwood Springs, which is located three-fourths of a mile from the southwestern corner of the Earlington quadrangle, and continues westward into Caldwell County. From Kirkwood Springs it extends in a slightly north of east direction and appears in the road just south of the Peter Howton coal bank, and again in the road west of

\*See report on Webster County.

Lick Creek. Continuing eastward it is traceable by displacement in the rocks and by the absence of Nos. 9 and 11 coals on the south to Sugar Creek. East of Sugar Creek the amount of displacement is less than to the west, but it continues eastward as far as the Victoria mine.

The Richland fault belongs to the normal, or extension class, with the down-throw side on the north. That is the north side has settled down, the south side remaining stationary.

The amount of displacement is greatest at the western edge of the quadrangle where it amounts to approximately 350 feet. On the north side of the fault at the Poke Lutz mine, which is located one-half mile west of the Earlington sheet, No. 9 coal is at an elevation of 420 feet above sea level. Immediately south of the fault No. 4 coal, with the limestone which comes between coals 4 and 5, is at the same elevation. The amount of displacement lessens gradually to the east, and at the extreme eastern edge of the quadrangle, in the Victoria mine, the displacement is only 8 feet.

**EFFECTS OF THE RICHLAND FAULT ON THE WORKABLE COALS.**—Since the fault has occurred, the surface of the country through which it passes has been greatly eroded. Some idea of the extent of the erosion may be had when one considers the fact that, at the point of greatest displacement, the fault fails to show any topographic evidence of its presence. In some places, however, scarps resulting from faults form a peculiar type of topography characteristic of a faulted region.

The effect of the Richland fault on Nos. 9 and 11 coals has been to swing the crop line six miles or more west of where it would have been without the fault, thus preserving a much larger area of these coals than would have otherwise been possible. A better idea of these conditions may be had by referring to the maps accompanying this report.

**STONY POINT CHURCH FAULT.**—An extension fault, with the down-throw on the north side, passes through the western end of Stony Ridge on which Stony Point Church is located. It has a trend of N. 75 degrees E. A narrow block of No. 9 coal has, by reason of this fault, been faulted down and preserved from erosion in the

same manner as that in the Beulah and Silent Run districts. The Tom Wanless and Brown mines, located just west of Stony Point Church, are working No. 9 coal in this faulted block.

**MINOR FAULTS.**—Minor faulting occurs to a greater or less extent over the entire area. The one having the greatest amount of displacement passes just northwest of Beulah and has a general direction of N. 57 degrees E. The down-throw is on the south side and has a vertical displacement of 70 feet. It fades out to the west, where it intersects the Richland fault. Continuing northeastward it loses itself in crossing the broad bottom of Silent Run and is not seen east of this.

A small fault, whose position is not well defined, occurs just south of Elam schoolhouse. It apparently has a northwest southeast direction, connecting two limbs of the Richland fault, which has an echelon structure at that point.

Faults of small moment occur in the railroad cut one mile north of Madisonville, and in the Madisonville and Hanson road two miles from the railroad station at Madisonville. The two faults are about parallel and trend N. 65 degrees E. The down-throw of each is on the north side. The amount of displacement could not be determined, but appears to be small. The region southwest of where these faults occur at the surface becomes level in a short distance and is covered with a blanket of surface clay and soil and makes further tracing in this direction impossible.

Some small faults also occur about two miles south of Slaughtersville with a trend of N. 70 degrees E. These faults occur near the bottom of the Webster-McLean syncline.

It is apparent from a study of the faults of the district under discussion that a large part of the area has been subjected to faulting of greater or less moment. And it is highly probable also that a large number of faults are covered with surface soils and will never be discovered except in mines. The greater part of these faults are of such small extent, both horizontally and vertically, that they need not prove any great obstacle to mining operations. The larger faults, instead of being a detriment, have been a decided benefit in adding to

the already large coal acreage left in the quadrangle after erosion.

The geographical position of the larger faults has likewise added to the advantage of the area. Had they occurred entirely north of the outcrop of No. 9 coal instead of intersecting the outcrop as they do the coal on the down-throw side would have been farther removed from the surface without increasing the coal area.

The presence of the No. 9 coal near Stony Point Church, and as far west as the Poke Lutz mine near Kirkwood Springs, and again at the Peter Howton mine, and at Beulah, has given rise to considerable speculation among coal men as to the area underlain by that coal.

In the Dawson Springs quadrangle to the south the No. 9 coal is worked in a large, down faulted block from Nortonville as far west as the Crabtree mine at Ilsley. The presence of the coal in these faulted blocks, so far removed from the normal outcrop of the No. 9 coal, has led many, not familiar with complicated faulting and its results on the coal seams, to naturally conclude that the coal likewise underlies the territory between Providence and Dawson Springs. However, a study of the maps of the Earlington and Dawson Springs quadrangles shows the location of the faults and the area where the No. 9 coal may be found.

#### UNCONFORMITIES.

An unconformity is a break in the sequence of the strata, or a cessation of deposition followed by a relative change of level in land and water. During the break in the continuity of the strata the rocks at the surface are subjected to erosion, which may be extensive or quite local. In some of the older rocks hundreds and even thousands of feet have been carried away by erosion, the surface later submerged and later rocks deposited on the uneven surface of the older rocks.

The most widespread unconformity in the rocks exposed in Western Kentucky occurs between the top of the Mississippian and the base of the Pennsylvanian. The former strata do not appear at the surface in this quadrangle.

There is some slight evidence of an unconformity coming at the base of the first sandstone below No. 9 coal, but it has no economic bearing in this quadrangle. Another unconformity occurs at the horizon of No. 11 coal that has caused the absence of this coal in the region just west of the Earlington quadrangle. This unconformity apparently did not affect the coal in this region except, perhaps, in the extreme northwestern part in the region of Lisman and in one or two small localities west and southwest of Nebo.

The Nebo coal, which is worked at Coiltown and Circle City, has a limited area in the Earlington quadrangle. Its absence is likewise due to an unconformity.

An unconformity occurs near the top of the Madisonville limestone, as may be seen in the town and vicinity of Madisonville. The extent of this unconformity is not known, but is thought to be of local nature.

Perhaps the last unconformity in the Pennsylvanian rocks is the one which comes between the thick deposits of shales, which underlie the Nebo lowlands, and the base of the coarse sandstone above. This is shown in the region north of Madisonville.

## ECONOMIC GEOLOGY.

### COALS.

By far the most important mineral product of the region described is coal. Pennsylvanian strata form the bed rock underlying the surface soil and sub-soil of the entire area. Coal beds occur at irregular intervals throughout the Pennsylvanian in this region. It is not to be supposed, however, that all of these coals are of sufficient thickness and extent to be profitably mined. In fact only a relatively small number of them are minable coals. In the region of outcrop of the workable coals streams have cut channels through the coals and carried away more or less of them, often leaving the deposits in narrow serrated ridges. North of Clear Creek the thicker coals dip rapidly to the north and quickly disappear below the surface, rendering it necessary to mine the coals by shaft.

The area of outcrop of commercial coals of the Earlington quadrangle is a belt of country two to three

miles wide, extending from Providence on the west to Earlington, and lying principally north of Clear and Sugar Creeks, with the exception of the faulted blocks just north of the Richland and the Stony Point faults. There are three valuable coals which outcrop in the above mentioned belt. These are No. 9, No. 11 and the Nebo coals. The Nebo coal is confined to the regions south and west of Nebo and Coiltown. The other two coals extend apparently unbroken across the quadrangle.

The coals can, under present conditions, be profitably worked over a broad area north of the outcrop belt before the northward dip carries them below a point where it is at present unprofitable to work them. At the Coil Coal Company, north of Madisonville, No. 11 coal is being worked at a depth of 285 feet below the surface. The mine is four and a half miles north of Earlington, where the same coal is mined on the outcrop.

There has been much speculation among those interested in coal lands of this part of the coal field as to the presence of Nos. 9 and 11 coals in the hilly region between Madisonville and Slaughtersville, and if present its possible maximum depth below the surface.

No. 9 coal covers an area in Kentucky, Illinois and Indiana, of more than 25,000 square miles\* and wherever present it maintains a very uniform thickness. It has been traced by outcrop and drill holes through eight counties of Western Kentucky. It is now being worked on the south, west, north and east sides of the Webster-McLean syncline and it would be very unusual if it does not occur there also.

Companies investing in coal lands have made the Morganfield branch of the Louisville and Nashville railroad from Madisonville to Nebo the northern limit of their holdings. It is only a question of time and demand for coal, however, when test wells will be put down north of this line and the presence of at least the No. 9 coal will be fully established.

\*Ashley, G. H., Thirty-third Ann. Rept. Indiana, Dept. of Geol., p. 83, 1909.

## MAXIMUM DEPTH OF NO. 9 COAL.

The Webster-McLean syncline, which has been described on a previous page, enters the Earlington quadrangle, from the north, runs generally northwest and southeast and leaves the sheet on the east between Slaughtersville and Madisonville, forming a wide, flat trough with sharp dips into the trough on the edges, these dips rapidly flattening toward the center, and the total rise out of the syncline partly due to these dips and partly to steplike faults parallel to the syncline. The maximum depth to the No. 9 coal, barring the possibility of faults, will be found along the line of this trough.

In the absence of drill holes which reach the horizon of No. 9 coal in the region of the Webster-McLean trough, the depth to the coal can only be approximated, but probably from 700 to 800 feet.

## DIP OF THE COALS.

In the region of Clay, which is located six miles northwest of Providence, the dip of the rock to the northeast varies from 98 to 214 feet to the mile, with an average dip of 160 feet to the mile. (See Plate I. A. and I. B.)

In the region of Providence the northward dip has decreased to a general average of 85 feet to the mile. (See Plate II.) From Coiltown to one-half mile west of the depot at Nebo the northward dip is 80 feet to the mile. (See Plate III.)

From the outcrop of No. 9 coal on the south side of Fort Ridge, two miles west of Earlington, to the No. 9 coal at Reinecke shaft, west of Madisonville, the general northward dip is 76 feet to the mile. Another estimate of the dip on No. 9 coal between the old Barnsley mine and the Victoria mine gives an average dip of 75 feet to the mile. (See Plates IV. and V.)

From Madisonville to Hanson the dip flattens to an average of forty-six feet to the mile. (See Plate VI.)

From the above statements it will be seen that there is a decided flattening of the northward dip from west to east. It must also be remembered that the above calculations were made in the region of, and for four or five miles north of the outcrop of No. 9 coal where the

dip in all probability is greater than it is in nearer the center of the basin. Estimating the dip from the outcrop of No. 9 coal, along the waters of Clear Creek, to the location of the Webster-McLean syncline, a distance of twelve miles, to be 80 feet to the mile,\* the depth of the No. 9 coal in the syncline would be 960 feet below the surface. Taking the general average of the dip in the region between Earlington to Madisonville as continuous to the deepest point in the syncline, No. 9 coal at the latter place would be 900 feet below the surface.

Separating the distance between the outcrop of No. 9 coal on the south and the location of the Webster-McLean syncline on the north into three divisions of four miles each, and giving to the first division a dip of 80 feet to the mile, 60 feet to the mile for the second division and 40 feet to the mile for the third division, the depth to No. 9 coal in the Webster-McLean syncline would be 720 feet below the surface. Even allowing for the possibility of faults, the latter estimate seems more probable than the former.

## QUALITY OF THE COALS.

All of the coals of the region under discussion are of a bituminous nature. In mining they yield approximately 60 per cent of lump where shot on the solid and 55 per cent where machine mined. They are, therefore, fairly hard coals which stand up well in shipment, and likewise stack well without spontaneous combustion. Some of the slack and nut of the district is made into coke at Earlington, but the pre-eminent field for these coals is for domestic, gas, and steam purposes. The presence of sulphur in both 9 and 11 seams, and the amount of gob and clay in the latter, render the coke unsuitable for blast furnaces. Fortunately also, the market to which they are most accessible demands mostly steam and domestic coals.

The quality of the coals of the district may be ascertained by a study of the analyses made by the U. S. Bureau of Mines in co-operation with the Kentucky Geological Survey and published in another part of this volume.

\*Too great for an average dip all the way.

## SHALE.

The Pennsylvanian rocks abound in shales suitable for the manufacture of drain tile, brick, sewer pipe, pavers and similar products. They occur in greatest abundance above No. 12 coal. Favorable locations for the erection of quarries and plants are to be had in the vicinity of Earlington, Madisonville and other places adjacent to the Louisville and Nashville railroad from Earlington to Slaughtersville, and also along the branch road from Madisonville to Providence.

## FIRE CLAY.

Very little investigation has been made of the underclays of the coal beds of this area. They range in thickness from one to eight feet. They are of a light gray color and contain more or less vegetable matter, which is consumed on burning. The few experiments that have been made show that the clays contain rather too high percentage of fluxing materials for first class fire brick. The following is an analysis of an underclay from a coal mine on Leonard Woody's place near Coiltown and sent to the office by the Nebo Consolidated Coal and Coke Company, of Nebo, Ky., with head office at Louisville. Analysis made by J. S. McHargue, Survey Chemist.

## Analysis of air-dried sample of Under Clay from Coiltown.

	Per cent.
Moisture at 100° C. . . . .	1.33
Ignition, combined water, carbonaceous matter. . . . .	10.57
Silica . . . . .	55.84
Alumina . . . . .	22.53
Ferric oxide . . . . .	0.24
Ferrous oxide . . . . .	3.31
Calcium oxide . . . . .	0.32
Magnesium oxide . . . . .	0.75
Potassium oxide . . . . .	3.24
Sodium oxide . . . . .	0.36
Titanium dioxide . . . . .	0.90
Sulphur trioxide . . . . .	trace
Total . . . . .	99.44
Total fluxes . . . . .	8.22

The total fluxes are too high where a highly refractory ware is required, but where medium temperatures only are necessary the clay could be used to advantage.

## BUILDING STONE.

The building stones of the region under discussion are principally sandstones, with one or two horizons of limestone. The sandstones occur in abundance below No. 9 coal and to a more limited degree in the upper part of the Pennsylvanian series. They occur as coarse, loosely cemented sandstone, suitable only for local use, to a hard fine-grained white to gray sandstone that might be quarried and used in foundations for buildings, railroad abutments and other places where strength and durability are required.

At two or three horizons thin limestones occur which are suitable for building material, lime and road ballast. The outcrops, however, are very local and usually contain so much overburden as to prevent an extensive use of the stone. There is a small quarry on the Madisonville limestone in the town of Madisonville where the limestone has been quarried for road ballast.

## SAND.

In the upper part of the Pennsylvanian is a coarse, loosely cemented sandstone which is very desirable as a building sand. Some of the coarser sandstones in the southern half of the area could also be crushed for sand. Practically all of the streams of the region contain large amounts of fine building sand throughout their courses.

## OIL AND GAS.

Owing to the unfavorable structure of the rocks of the region the chances for finding oil and gas here are meager. The strata of the entire area south of the Webster-McLean syncline have a general northward dip. The only marked variation of this is in the southwestern part of the quadrangle. In other parts of the area may be found an occasional swell, which has a slight reverse dip for a few feet or yards. The area north of

the large synclinal trough becomes a more favorable oil and gas territory as Sebree is approached, but it is hardly probable that any oil accumulation reaches as far south as Slaughtersville.

#### COALS BELOW NO. 9.

The lowest coal which occurs in the Earlington quadrangle is the one which comes at about the horizon of No. 4 coal. It outcrops at Kirkwood Springs, just west of this sheet, where the following section was obtained:

Section at Kirkwood Springs.		Feet.
9. Sandstone .....		
8. Sandy shale .....		20
7. Limestone, blue argillaceous .....		1
6. Sandy shale .....		10
5. Coal, No. 5 .....	thin	
4. Sandy shale .....		20
3. Sandstone with <i>Cauda galli</i> impressions .....		1
2. Sandstone and shale .....		18
1. Coal, No. 4 .....		

It barely enters the Earlington quadrangle in the extreme southwest corner. It is a soft smutty coal and is of no economic importance.

The coal shown in the above section, coming above the *Cauda galli* sandstone, and about ten feet below the thin blue argillaceous limestone, occurs over a larger area of the Earlington quadrangle than coal No. 4. It has been opened one-fourth of a mile northwest of Kirkwood Springs, but was found too thin to be profitably worked. It is reported to have been opened under three feet of blue limestone which outcrops in a branch near the extreme southwestern corner of the map at elevation of 480 feet above sea level. The coal is generally covered, but the limestone which lies close above it occurs in a number of places in the vicinity of Kirkwood Springs and as far east as one mile east of Lick Creek near where this stream enters the Earlington quadrangle.

North of the Richland fault the same limestone and associated coal occur on both sides of Lick Creek in the lower half of its course, as shown on the map. The coal where it has been opened was found too thin to be profitably mined. The limestone which occurs close above the coal in places contains a large amount of chert, which is quite resistant to the weathering agents and serves as an excellent criterion for determining geological horizons. The most northward outcrop of the cherty limestone observed by the writer occurs just north of Lick Creek, on the Kirkwood Springs and Providence road, one-eighth of a mile west of the Earlington quadrangle. From this point its outcrop line swings westward and has been observed in numerous places in Crittenden County as far west as Hoods, on Hoods' Creek, four miles southwest of Blackford.

South of the Earlington quadrangle on the headwaters of Lick Creek the coal under the limestone thickens to four feet or more.

From the cherty limestone horizon up to the first coal below No. 9 coal there are no coals of economic importance which outcrop in the area under discussion. At a point 75 feet above the chert horizon is a thin coal which occurs on the west side of Frazier ridge as shown in the following section of the hill on the Madisonville and Dalton road:

Section of Frazier Ridge.		Feet.
Sandstone alternating with shale .....		20
Shale .....		10
Covered .....		10
Sandstone .....		5
Gray shale .....		5
Coal .....		1½
Sandstone .....		1
Fire clay .....		2
Shale .....		10
Fire clay .....		2
Sandy shale .....		20
Covered—probably thin bedded sandstone .....		36
Covered .....		10
Cherty limestone .....		
Total .....		126½

The same coal has been opened in the ridge one mile west of Cavanaugh schoolhouse where it was two feet thick under a dark shale roof.

The interval from the above mentioned coal up to the No. 9 coal is largely filled with sandstone and contains two known coals, both of which are thin and worthless. On the hill one-half mile northwest of Beulah the relation of the first two coals below No. 9 is shown in the following section:

Section of hill northwest of Beulah.

	Feet	Inches
1. Sandstone .....		
2. Shale .....	2 to 6	
3. Black slate .....	3	
4. Coal, No. 9 .....	4	
5. Under clay .....	2	
6. Sandstone .....	18	
7. Coal .....	2	
8. Sandstone .....	50	
9. Coal .....	1	2
10. Flint clay parting .....	0	2
11. Coal .....	2	6

The lowest coal in the above section occurs 70 feet below No. 9. At no other place in the quadrangle has this coal the same characteristics as here. It occurs in a large amphitheater-like recess at the base of a coarse sandstone which forms a steep cliff in that region. The sandstone rests directly on the coal, which is of lenticular shape, and appears to be entirely cut out by the sandstone in a short distance to reappear again further on with a shale interval between the coal and overlying sandstone. Twelve to fourteen inches from the top of the coal is a two-inch band of flinty fire clay. This coal is at about the proper distance below No. 9 coal for coal No. 8-b, but it is lacking in the black slate roof which characterizes the latter coal of this region. This coal is too thick for coal No. 8-b which in this region has rather a uniform thickness of 18 inches.

Coal No. 8-b, with its characteristic black slate roof, has been opened on the east side of Richland Creek three-fourths of a mile south of Richland at an elevation

of 420 feet above sea level, and again on the Peter Boaz place one mile further up the creek.

At a few places where coal No. 8-b has been opened it has been mistaken for No. 9 coal. To the casual observer the roofs above the two coals are very similar. Where the slate of coal No. 9 is exposed to the surface agencies for a short length of time it disintegrates rapidly, due to the presence of iron pyrites, lime and organic matter, whereas, the slate above coal No. 8-b is finer-grained, contains less impurities and will stand for years with little sign of disintegration. It is often used for walks and door steps in regions where it occurs.

The interval between coal No. 8-b and No. 9 coal increases to the southeast from the Providence district. At bore hole 14 in Webster County the interval is 53 feet. At bore hole 17, two miles northwest of Earlington, the interval has increased to 68 feet. In the region south of the Earlington quadrangle the interval ranges from 70 to 100 feet and more.

In the upper half of the interval between coal No. 8-b and No. 9 coal are two thin limestones which occur in the region between Earlington and Richland, as shown by the following section:

Section 1½ miles east and south of Richland.

	Feet	Inches
Sandstone .....	15	
Shale .....	18	
Black slate .....	3	2
Coal, No. 9 .....	4	
Fire clay .....	3	
Limestone .....	thin	
Shale .....	30	
Coal .....	thin	
Fire clay .....	2	
Limestone .....	1 to 1	6
White fire clay .....	10	

The upper limestone occurs close under No. 9 coal about one mile southwest of the above mentioned location, and again two miles southwest of Earlington. At the latter place is a lower thin argillaceous limestone 40 feet below the outcrop of No. 9 coal.

Two miles southwest of Earlington the lower limestone outcrops at an elevation of 545 feet above sea level. Six feet below the limestone occurs the top of a sandstone which is 15 feet thick.

The lower limestone at the above mentioned places has been thought by some, not familiar with the formations, to be the limestone which occurs close above No. 11 coal. In each case, however, No. 9 coal, with its characteristic black slate roof, can be found in the hill 30 to 40 feet above the limestone horizon.

The lower limestone was passed through in digging the deep well on S. Hicks' land near the fair grounds at Providence where it was about 30 feet below No. 9 coal and had a thickness of 10 feet.

At the Owen Helm farm near Nebo (No. 27 of the well records) the limestone was struck at a depth of 39 feet below No. 9 coal.

#### NO. 9 COAL.

The area underlain by No. 9 coal in the Earlington quadrangle is approximately 178 square miles or 75 per cent of the entire area. No. 9 coal is the most persistent coal bed in Western Kentucky. It is rarely if ever entirely cut out by an unconformity. The average thickness of the bed is five feet, and it seldom varies twelve inches from this average. It is a solid coal without parting of any consequence, except an occasional thin band of pyrite which is never persistent for any great distance. The floor of the coal is invariably a light gray fire clay which is sufficiently hard to hold the overburden and tracks.

The characteristic roof of the coal is a black, carbonaceous slate which is from one to three feet in thickness, and contains round and oblong concretions of siderite or pyrite varying in size up to three feet in diameter. Frequently these concretions project downward into the coal and give trouble in mining. From twelve to eighteen inches above the top of the coal is a thin band of limy shale which contains marine fossils and sharks' teeth. It is known as the "periwinkle" rock. The shells are generally macerated, but in certain areas they are in perfect condition. The best preserved of these

fossils have been changed into marcasite which gives them a bright brassy appearance.

The outcrop line of No. 9 coal is shown on the accompanying map. Southwest of a general line drawn from the southeast corner of the quadrangle to Providence are two southward projections of coal due to block faults which have been described on a preceding page.

#### OUTLIERS.

In the region to the south and west of the main outcrop line are a few outliers of No. 9 coal. Most of these are small and so near the top of the ridges that the coal is of little value except for local purposes. The two largest outliers are separated from the main body of the coal by Clear Creek and Richland Creek and from each other by Silent Run.

The coal in these outliers underlies the ridges from Clear Creek on the north and extends as far west as Beulah. Outliers of smaller extent occur in the region of Kirkwood schoolhouse; a small area just south of Elam school and two on the extreme western boundary near the southwestern corner of the quadrangle. In each of these outliers the coal has been or is now being mined. On three high hills just west of Lick Creek, and one mile north of Elam schoolhouse, No. 9 coal barely caps the tops of the hills. A similar area, which at one time was connected with the Kirkwood schoolhouse outlier, occurs three-fourths of a mile to the north.

A few unimportant outliers also occur south of the main body of No. 9 coal in the Earlington district. In each of these the coal has either been worked out or is too near the surface to be of any value.

#### INDIVIDUAL MINES.

The coal is mined by drift and shaft at a number of places around Providence. To the southeast it is mined again at the Tom Wanless and the Brown mines in the faulted block just west of Stony Point church. At Coiltown it is mined by shaft at a depth of 300 feet. It is mined by drift in the region of Kirkwood Springs, Elam schoolhouse, Beulah and Silent Run church.

In the Earlington district it is mined by shaft at the Victoria, by drift at the Hecla, Earlington No. 9 mine and Arnold No. 9, and was formerly worked at the Barnsley, where it is now worked out. There are also a few country banks opened on the southwest side of Fort Ridge.

The same coal was formerly worked by shaft at the Reinecke mine west of Madisonville, but has been abandoned for the No. 11 coal.

The above mentioned places comprise the list of mines operating No. 9 coal in and adjacent to the Earlington quadrangle. Owing to the rapid northward dip which carries the coal below the surface in the central and northern parts of the quadrangle the zone of present operations is confined to and near its cropline. A discussion of the possible depth to the coal in the undeveloped parts of the quadrangle is found on a preceding page.

The relative position of No. 9 coal in the Pennsylvanian rocks is shown in the general section and in the numerous well records accompanying this report. In the Earlington quadrangle it is from 53 to 68 feet above No. 8-b coal, the distance becoming greater to the south.

The interval between No. 9 and No. 11 coals, in the region of Providence, ranges from 85 to 121 feet, with an average of 104 feet. In the region of Coiltown the average interval has thinned to 94 feet. The average interval in the region of Earlington, as determined by eleven test holes, is 79 feet. It thickens to the north of Earlington and from two records at Madisonville the interval is 96 feet. To the northeast of Madisonville, in the region of Anton, the average interval is 93 feet. Southeast of Earlington the interval continues to thin and at White Plains it is only 73 feet.

All of the mines operating No. 9 coal in the Providence district, with the exception of the Luton mine, are located just west of the Earlington sheet.

Providence is located on the outcrop of No. 9 coal, which is nowhere less than four feet six inches in thickness. The coal in six of the eleven mines operating the No. 9 coal in and near Providence averages four feet and ten inches in thickness. In four of the mines the

average thickness is four feet eight inches. In this district the coal has a strong black slate roof two to three feet thick and a fire clay floor which is generally, though not always, hard. The coal is free from any shale or clay partings, but thin streaks of iron pyrites are more or less common.

Most of the mines have spurs from both the Illinois Central and the Louisville and Nashville railroads, thus affording excellent outlets to the southern markets.

The total output of No. 9 coal in the immediate vicinity of Providence for the year 1911 was 357,883 tons.

**LUTON MINE.**—The ownership of the Luton mine has recently passed to the St. Bernard Mining Company, of Earlington, and at the time of the writer's visit the mine was undergoing a rehauling preparing for an increased output. The mine is located two and a half miles southeast of Providence, in Hopkins County, and is connected by spur to the Louisville and Nashville railroad. It is opened by shaft which is 107 feet to the bottom of the coal. The limestone, which comes just above No. 11 coal, outcrops on the hillside twelve feet higher than the top of the shaft. The coal averages six feet in thickness and has a black slate roof four feet thick and fire clay floor. The black slate roof has a large number of "nigger heads" the largest of which are two and one-half to three feet in diameter. The bottom of the coal is uneven or wavy, but the thickness of the coal varies but little. The dip of the coal is about two and one-half degrees north, thirty degrees east.

The mine is worked on the double entry system; the main entries and rooms are opened up the dip. Mule haulage is used to gather the coal to the shaft.

**THOMAS WANLESS MINE.**—The Thomas Wanless mine is located in the down faulted block just west of the Earlington quadrangle, a short distance from Stony Point church. The coal is opened on the south side of the hill on a strong northward dip. It was thought by opening the coal on the northeast side of the hill and working to the southwest the coal could be worked up the dip, but the water followed them to the center of the hill, showing a southwest dip on the north side of the hill.

Eight openings have been made on the coal in this faulted block. The average thickness of the coal is five feet. In one of these mines the coal is over 6 feet thick without parting.

The coal in this faulted block is more brittle than where it is unaffected by faulting. Where it is shot on the solid it makes about three-fourths slack and pea.

The coal mined at the Wanless and other mines on the Stony Point block is sold exclusively to the wagon trade.

**ROSE CREEK COAL COMPANY.**—The Rose Creek Coal Company is operating No. 9 coal at Coiltown. The company began operation in 1903 by mining the Nebo coal, which outcrops at the surface in and around Coiltown. The lack of a good firm roof over the Nebo coal proved too expensive to operate and in 1907 it was abandoned and a shaft sunk to No. 9 coal, which is 310 feet below the surface. The elevation of top of shaft is about 440 feet.

The No. 9 coal here averages five feet in thickness without parting. The black slate roof is about eighteen inches thick with a hard gray shale above. The bottom is a hard fire clay. The dip of the coal is about one and one-half degrees north to north five degrees west.

The mine is equipped with electric machines for cutting the coal, and electric motors for underground haulage. The daily output of the mine is about 500 tons of coal, but twice this amount has been taken out in rush seasons.

**POKE LUTZ MINE.**—The Poke Lutz mine is located on the most extreme southwestern outlier of No. 9 coal in the quadrangle. The mine is located in a down-faulted block with the main fault about one-fourth mile south of the mine. The No. 9 coal north of the fault is about on a level with No. 4 coal just south of the fault. The area of the No. 9 coal in the block in which the Poke Lutz mine is located, is confined to a very few acres. It is separated from the coal in the Peter Howton bank, presently to be described, by a branch of the Richland fault. It has been separated from the small block of No. 9 coal, one mile north of the Poke Lutz mine, by stream erosion, as shown on the map. It is quite possible, also, that

there is an east-west fault between the two which has dropped the coal in the Lutz block forty feet lower than it is in the block to the north.

The coal in the Lutz mine is five feet to five feet four inches thick without parting. It has the typical black slate roof, which is thirty inches thick at the mine mouth, and a fire clay floor. The roof has an occasional iron concretion so common in the roof of No. 9 coal. About six feet of dark gray shales occur above the slate roof. The dip of the coal in the mine is north thirty degrees east. The elevation of the mouth of the mine is 430 feet above sea level.

**PETER HOWTON MINE.**—The No. 9 coal has been opened in a small down-faulted block one-half mile south of Elam schoolhouse. It is opened in the south side of the hill and shows a strong dip to the northeast. The main Richland fault shows in the road 100 yards south of the mine mouth and cuts off the coal to the south. The elevation of the coal here is 480 feet. The following is a section at the mouth of the mine:

Section at Peter Howton mine.

	Feet	Inches
Covered . . . . .		
Black shale . . . . .	1	
Black slate . . . . .	3	
Coal without parting . . . . .	4	6
Fire clay		

A soft sandstone outcrops in the road twenty feet above the coal and forms a ledge on the hill to the west.

The block of No. 9 coal in which the Peter Howton mine is located is a small area which is confined between two divisions of the Richland fault. About one-fourth of a mile northeast of the Howerton opening is an old opening on No. 11 coal which is about the same elevation as the mouth of the Howton mine. There is evidently a northwest fault between the two places bringing No. 11 coal down on a level with No. 9 in a distance of one-fourth mile.

There are no other openings on the No. 9 coal west of Lick Creek. The dip carries it down forty to fifty feet below the level of Lick Creek bottom. A fault, the

location of which is not shown on the map, occurs in the Beulah road at the foot of the hill just east of Lick Creek. The effect of this fault has been to drop the No. 9 coal, west of Lick Creek, 140 to 150 feet lower than it is on the east side as the following data will show. The elevation of No. 9 coal at the Dockery bank, west of Beulah church, is 480 feet. The elevation of No. 11 coal one-half mile west of Lick Creek is at an elevation of 420 feet, which is eighty to ninety feet above the No. 9 coal.

**BEULAH DISTRICT.**—In the Beulah district there are five mines opened on No. 9 coal. They are operated periodically for the surrounding country trade and were all closed at the time of the writer's visit. At the Wilkes opening, one-half mile east of Beulah, four feet of coal are exposed with some covered at the bottom of the drift. The coal has a firm black slate roof with thirty-five feet of shale above and fifteen feet of coarse sandstone above the shale. The elevation of the coal is 460 feet.

At the Franklin mine, one-half mile south of Beulah, the coal is five feet six inches thick, with a black slate roof three feet thick. Iron concretions up to three feet in diameter, occur in the roof. The coal is reported to be too hard to shoot on the solid. Considerable amount of sulphur occurs within twelve inches of the bottom. The elevation of the mouth of the mine is 460 feet.

At the Brown mine, one-half mile southwest of Beulah, the same coal is opened at an elevation of 475 feet.

At the Dockery mine just west of Beulah church the elevation of the opening is 480 feet. The shale above the black slate roof is much thinner here than it is at the Wilkes bank east of Beulah. A fault of small throw occurs between here and the Wilkes bank dropping down the south side. The dip of the coal in the Franklin and Brown mines is to the northeast.

**SILENT RUN DISTRICT.**—Four mines have been opened on No. 9 coal in the vicinity of Silent Run church. The coal there has a due northward dip of fifty feet to the mile, with a due eastward dip of 40 feet to the mile.

At the Ligon mine, one-half mile west of north of Silent Run church, the coal is opened on the west side of the hill. At the mouth of the mine the coal is four feet thick without parting. Did not see full thickness on account of water in the mine. The coal has a dark shale roof, which weathers to chocolate color, with gray shale above. At the time of the writer's visit there was a considerable amount of sulphur on the old dump. The mine is only operated during the fall and winter for the country trade.

At the A. D. Kirkwood mine, one-fourth mile southwest of Silent Run church, No. 9 coal is opened at an elevation of 450 feet above sea level. The coal is four feet six inches to four feet eight inches in thickness without parting. Has black slate roof thirty inches thick and fire clay floor. Where the slate roof has fallen to a height of eighteen to twenty inches numerous fossils, so characteristic of roof of No. 9 coal, occur. The mine is operated during the fall and winter and the output is sold to the farmers of the surrounding country.

W. H. Kirkwood is operating the same coal a short distance west of Silent Run church on the east side of the ridge. The thickness of the coal is four feet five inches to four feet six inches with black slate roof. The roof contains a large number of concretions up to the size of a nail keg. The lower twelve inches of the coal contains a large amount of sulphur. Occasionally a fault is encountered which affects both roof and coal, but the amount of displacement is so small that the working of the coal is not greatly interfered with.

About one-half mile east of Silent Run church is an old opening on No. 9 coal of which four feet is exposed at the mouth of the mine. A part of the coal is covered with water. About forty feet above the coal is the base of a soft sandstone which is thirty feet thick. At a point ninety feet above the coal, on the high ridge to the east, is an outcrop of a hard blue limestone which marks the horizon of No. 11 coal. The hill is so covered with detritus that No. 11 coal does not outcrop, except as a slight stain under the limestone. There is a bed of shale immediately above the limestone, with a hard sandstone capping the crest of the ridge.

**HANSON SCHOOL DISTRICT.**—The ridge between Silent Run and Richland Creeks is underlain with No. 9 coal which outcrops in very few places ten to forty feet above the creek bottoms. There is apparently a small anticline, the axis of which is east and west and crosses the ridge about the location of Henson schoolhouse. North of this the strata dip to the north with a reverse dip to the south. The crop line of No. 9 coal on this ridge was located on the map principally by the position of No. 11 coal, which is present throughout the ridge, except in the low gap just south of Henson schoolhouse.

The No. 9 coal has been opened on the east side of the ridge about three-fourths of a mile southwest of the mouth of Richland Creek, at an elevation of 450 feet, and eighty feet below No. 11 coal. The opening, which is now closed, is in the first small drain north of the road leading over the ridge.

Another old opening, which is now closed, on what appears to be the No. 9 coal, has been made on the road side one-half mile west of Henson schoolhouse at an elevation of 420 feet. Twenty feet of shale occurs above the coal with a sandstone overlying the shale.

**EARLINGTON DISTRICT.**—The Saint Bernard Mining Company operates four large mines on No. 9 coal in the vicinity of Earlington. All of these mines are located directly on or within a few hundred feet of the Evansville branch of the Louisville and Nashville railroad. They are all equipped with the most modern mining machines, electric motors for underground haulage, fans and pumps.

Earlington is one of the oldest mining towns of this part of the State and its commercial interest is due to and dependent on the mining industry.

The country surrounding the town is hilly. It is located on the outcrops of Nos. 9 and 11 coals which rise rapidly to the south and in a short distance reach the crests of the highest ridges and disappear until they are brought down again in a large east-west faulted block in which Fox Run, Carbondale and Crabtree mines are located. The northward dip rapidly carries the coals below drainage level a short distance north of Earlington. The dip of the coals in the Earlington mines varies from 2 to 2½ per cent. or at the rate of about

105 feet to the mile. The average dip, however, from the outcrop of No. 9 coal on the south side of Fort Ridge to the Reinecke mine at Madisonville is only 76 feet to the mile.

The Richland fault, as shown on the map, crosses Fort Ridge about ½ mile south of the northwest end of the ridge, with a trend of north 71 degrees east. It follows the general direction of Clear Creek for nearly two miles and passes off the Earlington quadrangle one-half mile southeast of the Victoria shaft. The north side of the fault has dropped down relative to the south side. The amount of displacement on the west side of Fort Ridge is 35 to 40 feet and gradually becomes less to the eastern edge of the quadrangle where it is reported in the Victoria mine to be only 2 feet.

At the Hecla mine No. 9 coal is worked by slope with the opening on the east side of the ridge. The main entry follows in a general westward direction under Fort Ridge and has been extended for a distance of nearly two miles. The coal varies in thickness from 3 feet 4 inches to 5 feet with an average of 4 feet 8 inches. The northward dip of the coal is greater than the fall of the streams flowing north in Fort Ridge, so that the coal does not outcrop on the north side except at one place on Clear Creek where it has been brought up by the Richland fault. At the air shaft, which is located in the first large branch west of Hecla, No. 9 coal is reported to be only 12 feet below the bottom of the branch.

The coal has a black slate roof 18 to 24 inches thick and a fire clay bottom. The mine is equipped with electric chain-breast machines, and the drilling is done by electric rotary drills. Animal haulage is used for gathering the coal which is then hauled by electric motors to the tippie. The tippie is equipped for making six separations. However, lump, nut and slack are the separations usually made. The average daily output of coal is 14 cars of 40 tons each.

At the Earlington Number 9 mine the coal is opened by slope on the west outcrop of No. 9 coal in the corporation limits of Earlington. The elevation of the coal at the mouth of the mine is about 425 feet above sea level. The northward dip is a little greater than at the Hecla mine. The dip carries the coal down so rapidly that the

coal is worked under the branch bottom a short distance north of Hecla. The coal averages 4 feet 8 inches in thickness without parting. It has a black slate roof 18 to 24 inches thick and a hard fire clay bottom.

The entries, as far as possible, are driven north and south and the rooms east and west. The entries, break-throughs and room necks are 15 feet wide. At a distance of 15 feet from the entries the rooms widen to 22 feet, and are 500 feet long.

The coal is undercut by air compressor puncher machines, and drilled by rotary drills. The haulage is done by means of electric motors of 12 ton capacity. The trolley wires for the underground wires carry 300 volts.

The tippie is located directly on the main line of the Louisville & Nashville Railroad. It is equipped for making six separations when necessary. Lump and nut coals are loaded directly into cars. The slack is stored in bins and loaded by chute into large mine cars and drawn by mules to the coke ovens, where it is made into coke. In the dull season, when the demand for coal is small, the lump coal can be crushed and made into coke. The output is about 750 tons of coal a day.

The Arnold Number 9 mine is located just south of the corporation limits of Earlington. The mine is opened by slope on No. 9 coal. The elevation of the coal at the mouth of the mine is 454 feet above sea level. The dip in the mine is about  $2\frac{1}{2}$  degrees north to north 5 degrees east. The thickness of the coal varies from 4 feet to 4 feet 10 inches. The black slate roof is from 24 to 60 inches thick. The following is an average section of the mine.

Section at face of room No. 39 off 13th east entry, 5,000 feet from entrance. Depth below the surface at the point where section was made, 100 feet.

	Feet	Inches
Roof, black slate .....	2	
Hard coal .....	1	2
Sulphur band .....		$\frac{1}{2}$
Hard coal .....	2	$3\frac{1}{2}$
Sulphur band .....	thin	
Hard coal .....	1	
Total .....	4	6
Floor, hard smooth fire clay.		

The mine is equipped with the same kind of machines, drills and motor haulage as that found at the Earlington Number 9 mine. The output of the mine is 600 tons of coal a day.

At the old Barnsley mine the No. 9 coal has been worked out of the hill and the mine abandoned. The mine was located about  $1\frac{1}{2}$  miles southeast of Earlington, near the southeast corner of the quadrangle. The elevation of the coal at the mouth of the mine is 546 feet above sea level. The No. 11 coal was opened in the same hill 62 feet above No. 9 coal.

The Victoria mine is the most northward mine in the Earlington district where No. 9 coal is worked. It is located just east of the main line of the Louisville & Nashville Railroad two and a half miles north of Earlington and one-half mile south of the city limits of Madisonville. The mine is opened by shaft which is 265 feet to the bottom of the coal. The elevation of No. 9 coal is 199 feet above sea level. The No. 11 coal was struck in the shaft at a depth of 180 feet below the surface.

The average thickness of the coal is 5 feet. The coal has a black slate roof 2 feet thick and a fire clay bottom. The dip in the coal is to the north and averages  $2\frac{1}{2}$  degrees. In some places, however, it increases to 4 degrees. In places in the mine the sandstone above the coal comes down to within 12 inches of the coal. The black slate roof in places is absent or it may assume a thickness of 6 feet.

The mine is equipped with 16 air puncher machines and 5 electric undercut chain breast machines. The underground haulage is by means of electric motors. The underground trolley wires carry 250 volts. Ordinarily four separations of the coal are made. The output of the mine is 600 tons of coal a day.

#### NO. 11 COAL.

The No. 11 coal, in the Earlington quadrangle, comes next to the No. 9 vein in persistency and importance. It occurs 60 to 120 feet above No. 9 with an average interval of 80 feet. Coming as it does above No. 9 coal the crop line of No. 11 may be expected directly above, where the hills are sufficiently high to catch it, or,

in a more level region, slightly to the north of the crop line of No. 9 coal.

Where it is well developed No. 11 coal is by far the thickest seam in the district. It reaches its maximum thickness in the Earlington District where it is over 92 inches. In the Providence District the average thickness is 72 inches. The coal invariably has a clay parting, known as the "blue band" or "gray band," which is  $1\frac{1}{2}$  to 3 inches in thickness. It comes 24 to 32 inches from the bottom of the coal. There is generally present another parting of clay or sulphur which comes 10 to 18 inches from the top separating the coal into three benches. The top bench is the best quality and is known as shop coal or "gas coal." The high percentage of ash and sulphur frequently found in the coal comes in the lowest bench.

The coal is overlaid by a soft clay or "gob," which is from a few inches to a foot or more in thickness. In some regions the gob is displaced by a black slate which is from 1 to 5 feet thick and resembles the black slate above No. 9 coal even to the extent of containing the large lenticular concretions or "nigger heads" so common in No. 9 roof. These concretions are very common in the Arnold Number 11 mine at Earlington.

The criteria by which No. 11 coal is most easily determined are the clay parting in the lower half of the coal and the presence of a limestone close above the coal. Where the black slate is well developed the limestone may be very thin or entirely absent and its position taken by a shale. The limestone is usually fine grained, weathers to a gray color and contains marine fossils. Where present it is usually 4 to 5 feet in thickness and in a few localities it attains a thickness of 10 to 12 and even 20 feet. No. 12 coal lies close above the limestone.

PROVIDENCE DISTRICT.—The No. 11 coal is worked by slope at three mines in Providence just west of the Earlington sheet. At the Lamb mine the interval between No. 11 and No. 12 coals is shown in the following section as given by Mr. Lamb:

## Section at Lamb Mine, Providence.

	Feet	Inches
Shale .....		
Coal .....	3	2
Clay parting } No. 12 coal ..		10
Coal .....	3	
Fire clay .....		2
Limestone .....		5
Fire clay .....		1
Limestone .....	1	6
Gob or fire clay ..	1	6
Limestone .....	1	
Gob .....	0	3
Top of No. 11 coal.		

The coal outcrops in a number of places in the town of Providence. The limestone above the coal was encountered on Main street in excavating for a building. It disappears below drainage in the northern part of town.

At the Shamrock mine, which is located one mile east of Providence, the coal is worked by shaft at a depth of 71 feet below the surface. The elevation of the surface at the mouth of the mine is 401 feet. The coal averages 6 feet and has a limestone roof 8 feet thick with about 6 inches of gob between the coal and the limestone. The average dip of the coal is 3 per cent., north 28 degrees east. The coal has two regular partings, one the "blue band," 2 feet from the bottom, and the other a clay or sulphur parting 1 inch thick 1 foot from the top. The following is a record of the shaft:

## Record of Shamrock Shaft.

	Feet	Inches
No record .....	43	
Coal, No. 12 .....	5	
Shale .....	15	4
Limestone .....	6	2
Gob .....	0	6
Coal 1 ft.	6	0
Clay 1 in.		
Coal 2 ft. 9 in.		
Clay 2 in.		
Coal 2 ft.		
No. 11.....		

It is the purpose of the Saint Bernard Mining Company, who own the Shamrock and the Luton mines, to first work out the No. 11 coal of their holdings in this vicinity from the former shaft, and take out the underlying No. 9 coal from the Luton shaft, which is located  $1\frac{1}{2}$  miles southeast of the Shamrock.

The coal in the Shamrock is undercut by Sullivan air-puncher machines, and the holes are drilled by rotary air drills. The coal is gathered by animal haulage and conveyed to the bottom of the shaft by rope haulage. Ordinarily three separations of the coal are made: Slack, pea, with the nut and lump loaded together. The output of the mine is 800 to 1,000 tons of coal a day. At present the Shamrock is one of the largest producers in the district.

One-half mile due south of the Shamrock mine No. 11 coal is worked by slope at the Gaines mine. The mine is located just across the line in Hopkins County. The elevation of the mouth of the mine is approximately 400 feet. The average thickness of the coal is 6 feet. The output of the mine is sold exclusively to the local trade. The following is a section inside the mine:

Section at Gaines' mine.

	Feet	Inches
Limestone .....		
Gob .....	3	—24
Coal .....	1	2
Sulphur band .....		$\frac{1}{4}$ — $\frac{1}{2}$
Coal .....	4	
Mother coal .....		$\frac{1}{2}$ —1
Coal .....		$4\frac{1}{2}$
Mother coal .....		$\frac{1}{2}$ — $1\frac{1}{2}$
Coal .....		$4\frac{1}{2}$
Mother coal .....		$\frac{1}{2}$ — $1\frac{1}{2}$
Coal .....	1	6
Blue band .....		1 — 3
Coal .....	2	
Fire clay .....		

The No. 11 coal was opened and worked a number of years ago on Nick Parrish's place,  $1\frac{1}{2}$  miles a little south of east of the Luton shaft, but the opening is now filled with water. The elevation of the coal is slightly be-

low the level of Wier's Creek bottom, and the mine was abandoned on account of the water. It was 15 feet below No. 12 coal, which occurs above the No. 11 limestone. The No. 11 coal is reported by Mr. Parrish to be 7 feet thick in the mine.

COILTOWN DISTRICT.—An old opening, now closed, nearly two miles north of east of Stony Point church, on the south edge of Clear Creek bottom, marks the location of the old Brinkley mine. The opening was made by slope on No. 11 coal which has 4 feet of limestone close above the coal. The No. 12 coal outcrops on the slope 12 feet higher than No. 11 coal.

The old Brinkley mine is near the southern edge of a down-thrown block fault. The fault is plainly seen in the north-south road  $\frac{1}{4}$  mile west of the old Brinkley mine. The limestone above No. 11 coal outcrops in the road just north of the fault with a heavy bedded sandstone at the same level just south of the fault. The rocks in the fault plane are much broken and stand at an angle of 70 degrees.

An old opening has been made on No. 11 coal on the old Daniel Thomason place,  $1\frac{1}{2}$  miles southwest of Coiltown, near the edge of Clear Creek bottom, at an elevation of 400 feet. The limestone above the coal is 6 feet thick with 8 inches of gob between the limestone and coal. Four feet of coal are exposed at the mouth of the opening, but the full thickness of the coal was not seen. At an elevation of 35 feet above the coal is the base of a coarse grained sandstone which is 25 feet thick and forms an escarpment along the hill to the east and west.

An old opening on the north side of the hill,  $\frac{1}{2}$  mile southeast of the Thomason opening, was made a number of years ago on what is reported to be No. 11 coal. The opening is now entirely closed and the coal could not be seen. Shale occurs above the opening for a distance of about 8 feet above the top of the coal. The appearance about the opening looks unlike that above No. 11 coal. However, what is supposed to be No. 11 limestone outcrops in a number of places on the south side of the drain at about the same elevation as the mouth of the old coal bank. Beneath the limestone are 8 to 10 feet of gray calcareous clay with no sign of coal. Just back of Mr. Lewis' horse-lot is an outcrop of coal which comes

above the limestone, and is doubtless No. 12 coal. It is quite possible that the coal in the old opening above referred to is No. 12 coal.

The same limestone which occurs around Mr. Lewis' house outcrops in the road one mile to the east and again in the public road just north of Pound Creek. At the latter place the following strata are exposed:

Section in road  $1\frac{1}{2}$  miles south of Coiltown.

	Feet	Inches
1. Coarse sandstone		
2. Shale		
3. Coal (Nebo coal)		
4. Shale		
5. Sandstone		
6. Shale		
7. Coarse sandstone .....	5	
8. Thin bedded sandstone .....	4	
9. Shale .....	10	
10. Coal		
11. Clay parting } No. 12.....	0	8
12. Coal		
13. Fire clay .....	3	
14. Shale .....	3	
15. Limestone .....	4	
16. Thin coal		
17. Gray shale .....	20	

The strata from 1 to 6 inclusive were seen along the outcropping edges of the strata over a distance of three-fourths of a mile and the thicknesses were not determined.

At bore hole 26, located three-fourths of a mile northwest of where the above section was made, the top of No. 12 coal was struck at a depth of 32 feet. The elevation of the surface is about 440 feet above sea level. The No. 11 coal in this bore hole is 37 feet and 4 inches below No. 12 coal.

In a test hole 100 feet from the Rose Creek Coal Company's shaft at Coiltown the top of No. 11 coal was struck at a depth of  $185\frac{1}{2}$  feet below the surface. The thickness of the coal is reported to be 6 feet and 6 inches. The elevation of the surface is about 430 feet above sea level.

No. 11 coal is now being mined on the north side of Clear Creek within three-fourths of a mile of the mouth

of Greasy Creek. At the Moore bank, at the foot of the hill just north of the mouth of Greasy Creek, it is opened at an elevation of 375 feet. This mine has been opened a number of years and is operated throughout the year. The coal from this mine is largely used for shop coal at Madisonville, Nebo, Coiltown and Manitou.

The average thickness of the coal is 6 feet 9 inches. In a fall of the limestone in the mine No. 12 coal was exposed immediately above the limestone. The limestone was here 10 feet thick. The roof of the coal is a hard black slate which ordinarily stands up well and makes a substantial roof. A number of slips and rolls were observed, but only the roof was affected. The following is a general section of the mine:

Section at Moore Mine.

	Feet	Inches
Limestone .....	10	
Clay or gob .....	6	
Black slate .....	$1\frac{1}{2}$ to 7	
Coal .....	1	6
Hard sulphur band .....	0	$\frac{3}{4}$
Coal .....	2	$9\frac{1}{2}$
"Blue band" .....	0	2
Coal .....	1	10
Sulphur band .....	thin	
Coal .....	0	7

At the William Gibbons bank, a little more than one-half mile east of the Moore bank, No. 11 coal is opened by drift on the northeast corner of the oblong hill which lies between Clear and Greasy Creeks. The elevation of the coal is 380 feet. The coal above the blue band is 54 inches thick; the bottom bench was not measured. Black slate forms the roof of the coal and is 20 inches thick at the mouth of the mine. Six to 8 inches of gob comes between the black slate roof and the overlying limestone. The stain of No. 12 coal outcrops above the limestone.

No. 11 coal outcrops in the private road leading south of the east-west public road one-half mile southeast of the Gibbon's mine at an elevation of 410 feet above sea level. No. 12 coal shows as a stain 2 feet thick 12 feet above the top of No. 11.

**BEULAH DISTRICT.**—No. 11 coal has been opened in the down-faulted block one-half mile southeast of Elam school house at an elevation of 495 feet above sea level. It was so near the top of the hill that slips interfered with the mining and it was soon abandoned. The limestone above the coal shows in the old workings. The coal is reported to be 7 feet thick.

No. 11 coal catches under the high hill between Beulah and Fiddlebow school house and occurs in dissected outliers on the right between there and Clear Creek. It has been opened and worked for a time on Joe Tirey's place, one mile northeast of Beulah. It is on the northern edge of a down-throw faulted block, as shown on the map. The following is a section at the mouth of the mine:

Section at Joe Tirey's Mine, 1 mile northeast of Beulah.

	Feet	Inches
Hard blue limestone .....	3	
Gob .....	6	to 8
Coal .....		19½
Clay parting .....	½	to 1
Very hard shiny coal .....	2	4
Parting .....		½
Coal .....		6½
Blue band .....		3
Lower bench .....		

The lower bench of coal was covered with water and mud; it is said to be 26 inches thick.

**HENSON SCHOOL DISTRICT.**—One mile due south of Henson school house, on the old W. D. Mullenix place, No. 11 coal has been opened at an elevation of 435 feet, barometric reading, which is probably about 20 feet too low. The coal is reported to be 6 feet 3 inches thick. The following is a section at the mouth of the mine:

Section at the W. D. Mullenix Mine

	Feet	Inches
Sandstone .....	30	
Shale .....	20	
Coal No. 12 .....	5	
Limestone .....	4	
Gob .....		■
Blac slate .....	8 to 10	
Coal, No. 11, reported .....	6	6

Three-fourths of a mile northeast of the W. D. Mullenix bank is an old opening, now closed, on the same coal. The elevation of the coal is 455 feet. The coal outcrops in the branch above and below the "blue band" which is 3 inches thick. Blocks of limestone occur in the bank above the coal with a cliff-forming sandstone 15 feet above the coal.

No. 11 coal outcrops on the northwest side of the hill one mile north of Henson school house at an elevation of 485 feet. The crest of the ridge from here to the south is capped with a hard sandstone which is the Anvil rock sandstone of Owen. The hard sandstone has prevented the rapid erosion of the ridge. The following is a section of the hill:

Section of hill 1 mile north of Henson School House.

Broken fragments of limestone	Feet
Coal, No. 11 .....	5
Covered .....	25
Sandstone .....	40
Shale to bottom of hill .....	

The same coal outcrops under broken blocks of limestone in the road one-half mile northeast of Henson school house at an elevation of 530 feet.

**RICHLAND DISTRICT.**—One-fourth of a mile north of Richland, on the Richland-Manitou road, a mine is opened by drift on No. 11 coal. The elevation of the coal is 470 feet. The maximum thickness of the coal is 7 feet. The limestone above the coal is 4 feet thick with 6 to 8 inches of gob between the coal and limestone. No. 12 coal, reported to be 5 feet thick, outcrops in the road above the limestone. The mine is located a short distance north of the Richland fault which cuts off the coal to the south. A fault with a displacement about equal to the thickness of the coal was encountered in the mine with a trend of north 70 degrees east. Slips and rolls are common in the mine. The coal is of good quality and is mined for the country trade during the fall and winter.

At Lacy O'Bryan's, one-half mile northwest of the Richland mine, No. 11 coal and limestone occur on the west slope of the hill near the house at an elevation of

480 feet. Less than a quarter of a mile to the west the coal and limestone outcrop at the foot of the hill at an elevation of 430 feet, showing a strong westward dip or, what is more probable, a fault between the two localities.

On the extreme northwestern end of Fort Ridge No. 11 coal has been opened under a limestone at an elevation of 430 feet. One mile due southeast, on the south side of Richland fault, the same coal outcrops in the road at an elevation of 540 feet.

The crest of Fort Ridge is capped with a coarse sandstone the base of which is about 50 feet above the limestone above No. 11 coal. No. 9 coal outcrops near the foot of the ridge.

No. 11 coal in Fort Ridge is unbroken from the extreme northwestern corner to a point about half way to Hecla. In the eastern half of the ridge the continuity of the coal has been broken by two branches which have cut through the coal and left it in long finger-like ridges extending north and south. On the extreme southern extension of the ridge, south of the Earlington and Richland road, are two small outliers where the coal is within 15 feet of the crest of the hills.

One-half mile south of Hecla the following is a section of the hill above the outcrop of No. 11 coal:

Section ½ mile south of Hecla.	
	Feet
Sandstone capping top of hill	
Siliceous shale .....	40
Coal, No. 12	
Clay .....	2
Limestone .....	4
Coal, No. 11	

EARLINGTON DISTRICT.—The most extreme southern outcrop of No. 11 coal in the Earlington quadrangle is just south of the old Barnsley mine, near the southeastern corner of the quadrangle. An opening was formerly made on No. 11 coal at this place at an elevation of 608 feet. The limestone above the coal is 4½ feet thick with 6 inches of gob between the limestone and coal. The coal at the mouth of the entry is 6 feet 7½ inches thick. The coal is so near the crest of the ridge that slips and "troubles" prevented its being worked.

No. 11 coal is worked extensively by the St. Bernard Mining Company in two of the large mines at Earlington. They are the Earlington Number 11 and the Arnold Number. 11.

The Earlington Number 11 mine was one of the first opened at Earlington. It is located just east of the main line of the Louisville & Nashville Railroad, near the northern boundary of the city limits. The elevation of the mouth of the mine is 457 feet. The thickness of the coal at the mouth of the main entrance is 80 inches. The "blue band" is here 28 inches from the bottom. The following is a section at the mouth of the main entry:

Section at mouth of Number 11 Mine, Earlington.

	Feet	Inches
Coal, No. 12 .....	4	
Limestone .....		15 to 18
Black shale .....	4 to 5	
Gob .....		6
Black slate .....		8
Coal, No. 11 . . . . .	6	8

The coal has been worked out under the first ridge east of Earlington and the coal is now coming from a new opening 1½ miles due east of the depot.

The limestone is not everywhere present above the coal in the Earlington Number 11 and in the Arnold Number 11 mines. In both mines the limestone, with 3 to 10 inches of gob between the limestone and the coal, occurs on the east slopes. On the west slopes the limestone is usually absent, the roof of the coal being composed of about 2 feet of black slate with about the same amount of gray clay or soft shale above to No. 12 coal. The black slate makes a good roof. Where a fall occurs on the west entries it falls to the base of No. 12 coal. In some places the base of No. 12 coal comes down to within 18 inches of No. 11 coal.

The underground haulage is by means of electric motors. From the mouth of the mine to the tippie, a distance of about 1¾ miles, the coal is hauled by a 20-ton steam locomotive. Sullivan air-puncher machines are used for undercutting the coal. The holes are drilled

with Jeffrey rotary air drills. The output of the mine is about 800 tons of coal a day.

The tippie is equipped for making the standard separations, but when trade does not demand it the finer separations are converted into coke.

At the Arnold Number 11 mine No. 11 coal is opened by slope in the same hill as the Arnold Number 9 mine. The two tippies are only 400 feet apart and the coal from each mine is hauled to the main line of the railroad over the same spur. It is reported that No. 11 coal here is only 48 feet above No. 9, which is the minimum distance between the two coals in this part of the State. The following is a general section of the mine:

Section in the Arnold No. 11 Mine.

	Feet	Inches
Shale		
Rotten limestone		3 to 8
Coal, No. 12	3 to 4	6
Shale	1½ to 2	
Limestone	4 to 7	
Black slate	2 to 5	
Coal	1	6
Parting	0	1
Coal No. 11	3	3
Blue band	0	2½
Coal	2	8
Fire clay	3 to 4	

The best coal is the top bench, which is known as "shop coal."

The mouth of the mine is 1,700 feet from the tippie. The haulage is by means of electric motors. The coal is undercut by Sergeant air-puncher machines, and drilled by Jeffrey rotary air drills. The output of the mine is about 600 tons of coal a day.

MADISONVILLE DISTRICT.—At the Reinecke mine, one mile west of Madisonville, No. 11 coal is worked by shaft which is 265 feet deep. The elevation of the surface is approximately 425 feet above sea level. No. 9 coal was originally worked there, but that seam was abandoned a few years ago and the shaft sealed to No. 11 coal. The coal varies from 6 to 8 feet in thickness with general

average of 6½ feet. The dip of the coal is to the north and is 28 to 30 inches in 100 feet.

An unconformity similar to that noted in the Earlington and Arnold Number 11 mines at Earlington exists on No. 11 coal in the Reinecke mine. The coal is more or less disturbed by small vertical cracks which are filled with clay, and on the average extend half way through the coal. These "clay slips," as they are called, are V-shaped in structure with the sharp end downward.

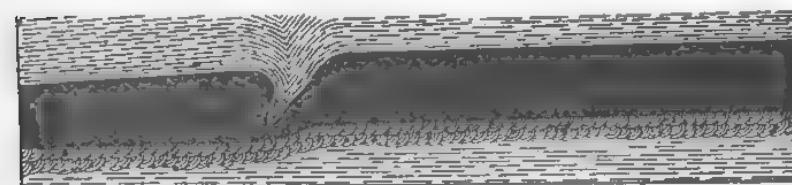


Figure 1.

The thin shale or "gob" and the black slate between the coal and the overlying limestone is irregular in thick-

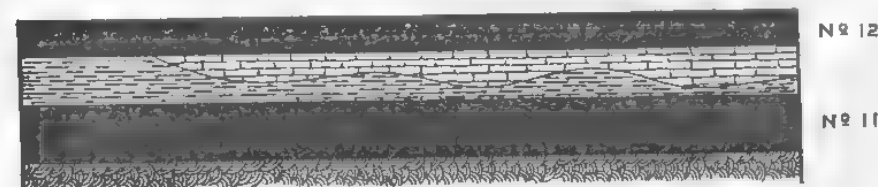


Figure 2.

ness as shown in figure 2. At or near the base of the black slate is a thin iron band which is always present. It varies from a knife-edge thickness to as much as 4 inches.

The coal is undercut by electric chain-breast machines, and drilled by electric rotary drills. The coal is gathered by means of animal haulage and conveyed to the shaft bottom by electric motors. The underground trolley wires carry 500 volts. The mine throughout is one of the best equipped of the district. Steel ties are being installed with 40 pound rails on the main hauls. The output of the mine is 1,200 tons of coal a day.

## NO. 12 COAL.

The position of No. 12 coal is close above the limestone which overlies No. 11 coal. The limestone is a variable quantity, in places being entirely absent while in other parts of the territory it is 12 to 20 feet thick. Where the limestone is absent its place is taken by a shale or clay, and No. 12 coal may come down to within 18 inches of the top of No. 11 coal.

The interval between the two coals varies greatly in different parts of the quadrangle. In the town of Providence the average interval is about 5 feet. Three to four miles to the northeast it has increased to 20 feet, and if the well records are correct, the interval is still greater in the region of Nebo and Coiltown. The average interval in the Earlington District, as taken from eleven well records and openings, is 7 feet. The variation in the interval between the two coals is due to an unconformity at the top of No. 11 coal. The unconformity usually affects the roof of No. 11 coal, but in some localities the entire seam was removed by erosion soon after its accumulation.

No. 12 coal is very unreliable in thickness and is nowhere worked in the Earlington quadrangle. Its greatest thickness observed was in the town of Providence. It has a soft shale roof which makes it difficult to work even where the thickness of the coal would justify it. The shale extends from the top of No. 12 coal to the base of the Anvil rock sandstone. The distance between the top of No. 12 coal and the base of the Anvil rock sandstone varies from 20 to 45 feet.

At the Lamb Coal Company's mine at Providence No. 12 coal has an unusual development of 7 feet with a 10-inch clay parting 3 feet from the bottom. In digging the incline to No. 11 coal the coal from No. 12 was used in the boiler until the former was reached and was regarded as an excellent steam coal.

Four miles southeast of Providence, on the Nick Parrish place, at an old opening on No. 12 coal the following section was obtained:

## Section at Nick Parrish Place.

	Feet	Inches
Sandstone .....	20	
Shale .....	10	
Coal .....	2	
Shale parting } No. 12.....		8
Coal .....	2	
Fire clay .....		
Limestone .....	11	
Gob .....		4
Coal, No. 11 .....	4½ to 7	

At no other place in the region under discussion has No. 12 coal been opened. It is present over the limestone at the old Brinkley mine northeast of Stony Point church; at the Moore and Gibbons mines near the mouth of Greasy Creek, in the ridges between Silent Run and Richland Creeks, and also at the Richland mine. It is also present at the mouth of the Earlington Number 11 mine in the Arnold mine.

In bore record No. 4, in the Maloney bottom, 3 miles east of Providence, No. 12 coal is 5 feet thick. In bore record No. 1 it is 7 feet thick while in bore No. 15 it is only 1 inch thick.

The coal is present in all the bore holes, begun sufficiently high to catch it, between Earlington and Madisonville. The thickness varies from 2 feet in bores 11 and 23 to 4 feet 6 inches in bore 13.

In the Reinecke shaft it was 4 feet 6 inches and only 1 foot 6 inches at the City Ice Company's well at Madisonville.

## NEBO COAL.

In the region west of Nebo, Coiltown and Circle City is a coal which occurs about 185 feet below the lower Madisonville limestone and 115 to 125 feet above No. 9 coal. This coal is generally regarded by those mining it as Coal No. 14, but there is some doubt as to whether there is another coal between this and No. 12. In bore hole 14 it is the first coal above No. 11 while in bore 15 it is the second coal above No. 11. In bore 14 the distance between the Madisonville limestone and the coal is 184 feet, and 185 feet for the same interval in

bore 15. In bore 20 coals Nos. 11 and 12 are absent and the Nebo coal is here the first coal above No. 9. The interval between the Madisonville limestone and the Nebo coal in this bore is 189 feet. The distance between the Madisonville limestone and the Nebo coal increases to the southeast and in bore 16, three miles west of Nebo, it is 209 feet and 6 inches.

The Nebo coal is correlated with the coal found over a considerable area in Webster County, in the region of Clay, Wheatcroft and Hearin and now mined at Baker. This correlation was first suggested by Glenn in Bulletin No. 17, Kentucky Geological Survey, 1912. His correlations were based on its position with reference to No. 9 coal. Since there is considerable irregularity in the interval between No. 9 coal and the Nebo coal due to unconformities the writer has endeavored to make the correlation with reference to the Madisonville limestone. Recent investigations in Henderson County indicate that the Smith Mills and Corydon coals can be correlated with the Nebo coal.

In nine core hole records in the region of Wheatcroft, Hearin and Clay, Webster County, the interval between the lower member of the Madisonville limestone and the Nebo or Baker coal varies from 153 to 169 feet, with a general average of 162 feet. This shows a thinning of the interval between the coal and the Madisonville limestone to what it is in Hopkins County. In the same region of Webster County the interval between No. 9 coal and the Madisonville limestone averages 285 feet. At the Rose Creek Coal Company's shaft at Coiltown the interval between No. 9 and the Nebo coal is about 294 feet. If we add to this 185 feet, the distance from the Nebo coal up to the Madisonville limestone, the interval between No. 9 coal and the Madisonville limestone at Coiltown would be 479 feet. There seems to be some inconsistency in the core records at Coiltown and Circle City, since the core record No. 27 on the Owen Helm farm, near Nebo, gives an interval between No. 9 and the Madisonville limestone as 311 feet. At the Mitchell and Parrish place, southwest of Nebo, the interval from what is regarded as the Madisonville limestone to the base of the sandstone overlying No. 9 coal is 262 feet. In bore 14 the interval between the

Madisonville limestone and No. 9 coal is 302 feet, while in bore 16 it is 310 feet. In bore 20 the same interval is 308 feet. It may seem, therefore, that the interval between the Madisonville limestone and No. 9 coal in the Earlington quadrangle is slightly more than 300 feet, whereas the same interval further west in Webster County decreases to approximately 285 feet.

The Nebo coal occurs in large lense-shaped bodies. It may be found in one locality while nearby it is absent to reappear in another place, as shown in the bore records accompanying this report. Where present it is an excellent quality of coal and contains less impurities than any other coal in Western Kentucky, except the Bell coal. In the Nebo Consolidated Coal Company's mine it is 6 to 7 feet thick without parting. It is a bright shiny coal somewhat softer than No. 9. In the above mentioned mine it contains a rider of coal  $1\frac{1}{2}$  to 2 feet thick 3 to 5 feet above the top of the main body of the coal. This rider was not observed at any other place, and is not shown in any of the drill records. In Webster and Henderson Counties this rider has thinned to 1 inch or less in thickness.

It has a soft shale roof which requires almost solid timbering to hold the roof. At the Circle City mine about 18 inches of coal at the top is left for a roof. The shale above the coal extends upward to the base of a coarse sandstone. It is underlain by 18 inches of fire clay. V-shaped "clay slips," as shown in figure 2, are frequent in this mine near the crop.

The Nebo coal was formerly worked by slope at Coiltown in a number of places. The only mine in this quadrangle now operating this coal is the Nebo Consolidated Coal Company's mine at Circle City. The mine was opened in 1906 by drift and the coal brought to the tippie over a double conveyor. The old slope was finally abandoned on account of the poor condition of the roof and a new slope opened to the west and the coal is now hauled by electric motors to the old tippie.

The following is a section inside the mine:

## Section in Circle City Mine.

	Feet	Inches
Shale		
Coal rider .....	1½	to 2
Gray shale .....	3	to 5
Coal, left as roof .....	1	6
Sulphur parting .....	thin	
Coal .....	5	10
Rash .....	3	to 5
Fire clay		

The dip in the mine is 1 to 3 degrees north, 2 degrees east. The coal is undercut with electric chain-breast machines and drilled with electric rotary drills. The output of the mine is about 500 tons of coal a day.

## COALS ABOVE THE NEBO COAL.

The interval between the Nebo coal and the Madisonville limestone, a distance of about 185 feet as shown by the drill records of the Earlington quadrangle, is filled with shales and sandstones without any trace of coals. There are, however, four or five coals in the interval between the Madisonville limestone and the top of the Pennsylvanian series.

## THE MADISONVILLE LIMESTONE.

The Madisonville limestone contains two to four divisions ranging through a maximum interval of 40 feet. It is persistent over a wide area in Western Kentucky, easily recognized and is one of the most reliable stratigraphic markers of the upper Pennsylvanian rocks. It is hard, brittle, very resistant to the weathering agents, weathers to a gray color and carries an abundance of marine fossils. Between the beds of limestone are intervals of red clay and shale which are important stratigraphic markers in the upper Pennsylvanian series.

The coals above the Madisonville limestone are thin and can not be considered even remotely as commercial coals. Two of the seams are of sufficient thickness to be worked for local trade. The lowest of these occurs near the foot of the escarpment bordering the northern edge of the Nebo lowland.

It lies close above an argillaceous limestone 3 feet thick without fossils. The coal is overlain by a black shale which is 2 to 3 feet thick with a soft gray shale above. The coal rests on a bed of fire clay. Where seen the coal is a black shiny coal without parting, somewhat softer than No. 9, and is said to be an excellent domestic coal. It has been opened in a few places between Stanhope and Friday school house.

The coal has been opened in two places about three miles north of Nebo on the headwaters of Weir's Creek. At an old opening in the bank of the branch one-half mile west of Yarbrow school house the following section is exposed:

## Section one-half mile west of Yarbrow School House.

	Feet
Coal reported to be .....	3
Fire clay .....	7
Limestone .....	3
Gray shale .....	10

The elevation of the coal is 460 feet.

Three-fourths of a mile northwest of the Yarbrow opening the same coal has been opened in the bottom of a branch at an elevation of 440 feet. It has a black shale roof 3 feet thick with 5 feet of gray shale above. The coal lies close above a thin limestone.

What is perhaps the same coal outcrops in the road one-half mile south of Stanhope under a dark-gray shale with fire clay floor. The thickness of the coal is 22 inches without parting. The elevation of the coal is 460 feet.

A coal which lies close above a thin limestone has been opened in a number of places on the headwaters of the East fork of Pond Creek, southwest of Friday school house. This is evidently at the same geological horizon as the Yarbrow coal. The coal is about 2 feet thick and has a black slate roof 2 to 6 feet in thickness.

On Mr. E. P. Lutz's place, three-fourths of a mile a little west of south of Friday school house, is an old opening, now closed, on a coal that appears to be a few feet above the Yarbrow coal. The higher coal is said to be 4 to 6 feet thick with a soft shale roof. The thick

coal has a band of sulphur near the center and contains more or less lifeless bone or rash.

Three miles south of east of Friday school house, and three-fourths of a mile north of the County Poor Farm, a coal was formerly worked at what is known as the Brown bank. Mr. Walter Thomson, of Madisonville, who opened the mine, stated that the coal is 30 to 32 inches thick without parting. It has a black shale roof and fire clay floor. The mine was abandoned on account of the poor roof. Mr. Thomson stated that the coal was free from impurities and burned to a white ash.

A higher coal was opened a number of years ago at the foot of the hill west of Buntin schoolhouse, but the opening is now closed and nothing was learned of the nature and thickness of it.

In the road one and a half miles southwest of Slaughtersville is a coal which outcrops near the foot of the hill near the East Fork of Deer Creek. The rocks here show a decided dip to the south. The following is a section of a part of the hill:

Section one and a half miles southwest of Slaughtersville.

	Feet	Inches
Shale		
Coal	3	
Clay	1	6
Coal	2	
Shale	10	
Sandstone	1	6
Shale	4	
Sandstone	1	6

### BORE AND SHAFT RECORDS.

Unless otherwise stated the following bore-hole records were furnished the writer by the Saint Bernard Mining Company, of Earlington. The numbers here given have corresponding numbers on the map.

Bore No. 1, two and a half miles east of Providence, Webster County. Elevation of surface 390 feet. Depth to bottom of No. 9 coal, 285½ feet. Elevation of No. 9 coal, 104½ feet A. T.

	Feet	Inches
Dirt	4	
Sand and shale	16	
Shale	9	
Limestone—Madisonville	2	
Shale, sandy and calcareous	108	
Black slate	0	6
Limestone	4	
Limestone, soft	14	
Shale	1	6
Coal—Nebo	7	
Fire clay	1	
Limestone	18	
Coal	7	
Fire clay	3	
Limestone	15	
Sandstone	42	
Gray shale	25	
Black slate	3	
Coal, No. 9	5	6
Total	285	6

Drill hole No. 2, two miles southeast of Providence, Hopkins County. Elevation of surface, 358 feet. Depth to bottom of No. 9 coal, 119 feet. Elevation of No. 9 coal, 239 feet A. T.

	Feet
Surface	16
Coal, No. 11	5
Sandstone and slate	93
Coal, No. 9	5
Total	119

Drill hole No. 3, on east Powell Place. Elevation of surface, 374 feet. Depth to bottom of No. 9 coal, 216 feet. Elevation of No. 9 coal, 158 feet A. T.

	Feet	Inches
Clay .....	15	
Limestone .....	15	
Shale .....	40	
Sandstone, white .....	12	
Sandstone, gray .....	6	
Coal .....	5	2
Fire clay .....	1	6
Limestone, bastard .....	3	
Sandstone .....	3	
Limestone, bastard .....	26	
Shale .....	9	
Sandstone .....	41	
Black shale .....	33	
Coal, No. 9 .....	6	6
Fire clay .....	6	
Sandstone, white .....	32	6
Total .....	254	8

Drill hole No. 4, located 3,120 feet west of No. 3. Elevation of surface, 364 feet. Depth to bottom of No. 9 coal, 160 feet. Elevation of No. 9 coal, 204 feet A. T.

	Feet
Surface .....	24
Hard rock .....	2
Sandstone, soft .....	19
Coal, No. 12 .....	5
Sandstone, soft yellow .....	3
Limestone .....	2
Coal, No. 11 .....	5
Fire clay .....	19
Sandstone, white .....	21
Shale .....	15
Sandstone, black .....	10
Black slate .....	8
Fire clay .....	21
Coal, No. 9 .....	6
Total .....	160

Drill hole No. 5, on east Powell place. Depth to bottom of No. 9 coal, 200 feet.

	Feet	Inches
Surface .....	12	
Shale .....	56	
Sandstone, gray .....	4	
Black slate .....	4	
Coal .....	6	
Fire clay .....	2	
Limestone, bastard .....	14	
Shale .....	9	
Sandstone .....	56	
White slate .....	37	
Black slate .....	3	6
Coal, No. 9 .....	6	6
Fire clay .....	1	
Total .....	201	

Drill hole No. 6, on I. B. Smith's place, two miles west of north of Earlington. Elevation of surface, 418 feet. Elevation of No. 11 coal, 342 feet. Elevation of No. 9 coal, 253 feet A. T.

	Feet	Inches
Surface .....	10	
Limestone and Sandstone .....	8	
Limestone .....	12	
Shale .....	32	6
Coal, No. 12 .....	2	6
Limestone .....	4	
Coal, No. 11 .....	7	4
Fire clay .....	3	
Shale .....	14	
Sandstone .....	6	
Shale .....	5	
Sandstone .....	14	
Gray slate .....	39	2
Black slate .....	4	
Coal, No. 9 .....	4	2
Total .....	165	8

Drill hole No. 7, on Jenkins' place, three miles north of Earlington. Elevation of surface, 407 feet. Elevation of No. 11 coal, 310 feet A. T.

	Feet	Inches
Surface .....	16	
Shale .....	7	
Coal .....	1	2
Clay .....	6	
Limestone, white .....	7	6
Shale .....	15	
Soapstone .....	13	
Shale .....	7	
Soapstone .....	4	
Slate .....	1	
Coal, No. 12 .....	4	
Fire clay .....	1	6
Limestone .....	6	
Slate .....	1	
Coal, No. 11 .....	6	6
Fire clay .....	0	6
Total .....	97	2

Drill hole No. 9, on Hunting Branch, north of Earlington. Elevation of surface, 407. Elevation of No. 11 coal, 339. Elevation of No. 9 coal, 256 feet A. T.

	Feet	Inches
Surface .....	12	
Shale .....	38	
Coal, No. 12 .....	4	
Slate .....	10	
Coal, No. 11 .....	6	6
Fire clay .....	3	
Shale .....	45	
Shale and gravel .....	20	
Slate .....	9	
Coal, No. 9 .....	6	
Total .....	153	

No. 10, new air shaft at Victoria mine. Elevation of surface, 411 feet. Elevation of No. 11 coal, 343 feet. Elevation of No. 9 coal, 254 feet A. T.

	Feet	Inches
Blank .....	52	
Coal, No. 12 .....	4	6
Limestone .....	2	
Fire clay and gob .....	3	6
Coal, No. 11 .....	7	
Blank .....	84	
Coal, No. 9 .....	4	
Total .....	157	

No. 11, drill hole on I. H. Stone's place, north of Earlington. Elevation of surface, 402 feet. Elevation of No. 11 coal, 323 feet. Elevation of No. 9 coal, 234 feet A. T.

	Feet	Inches
Surface .....	17	
Sandstone .....	16	
Shale .....	28	
Coal .....	2	
Fire clay .....	2	
Slate and limestone .....	2	
Limestone .....	4	6
Slate .....	2	6
Gob .....	2	
Sulphur .....	1	
Coal .....	1	6
Fire clay .....	1	6
Shale .....	3	
Sandstone, hard .....	2	
Sandstone .....	55	
Slate, gray .....	18	6
Slate, black .....	4	
Coal .....	4	10
Fire clay .....	0	4
Total .....	167	8

Drill hole No. 13, on Chappell place, west of north of Earlington. Elevation of surface, 436 feet. Elevation of No. 11 coal, 311 feet. Elevation of No. 9 coal, 224 feet A. T.

	Feet	Inches
Surface .....	4	
Soapstone .....	30	
Shale .....	20	
Soapstone .....	10	
Limestone .....	3	
Shale .....	9	
Sandstone .....	11	
Soapstone .....	19	
Slate .....	1	
Coal, No. 12 .....	4	6
Fire clay .....	1	6
Limestone .....	5	
Slate .....	1	6
Coal, No. 11 .....	6	
Fire clay .....	1	6
Soapstone .....	15	
Shale .....	18	
Sandstone .....	20	
Soapstone .....	24	6
Slate .....	3	6
Coal, No. 9 .....	4	6
Fire clay .....	0	6
Total .....	213	

No. 14. Drill hole on Henderson Foxwell place, four miles northeast of Providence, Webster County. Elevation of surface, 391 feet. Elevation of No. 9 coal, 115 feet below sea level.

	Feet	Inches
Surface .....	12	
Shale .....	103	
Shaly limestone. . .	10	
Shale .....	25	
Limestone .....	6	
Shale .....	14	
Limestone .....	1	
Red clay .....	13	
Shale .....	1	
Red shale .....	9	
Limestone .....	4	
Shale .....	14	
Sandstone .....	30	
Shale .....	115	
Sandstone .....	5	

	Feet	Inches
Shale .....	20	
Coal .....	2	6
Fire clay .....	4	
Limestone .....	0	6
White clay .....	3	
Limestone .....	12	6
Gob .....	0	6
Coal .....	0	6
Fire clay .....	4	6
Limestone .....	1	
Shale .....	10	
Sandstone .....	42	
Shale .....	35	
Black slate .....	3	
Coal, No. 9 .....	5	
Fire clay .....	2	
Limestone .....	2	
Sandstone .....	17	
Shale .....	14	
Sandstone .....	16	6
Black slate .....	2	
Coal .....	0	6
Fire clay .....	10	
Shale .....	13	
Black shale .....	3	6
Coal .....	4	
Fire clay .....	0	6
Shale .....	7	
Total .....	598	

Drill hole No. 15, on James R. McGaw's place, near McGaw schoolhouse, Webster County. Elevation of surface, 432 feet.

	Feet	Inches
Soil and clay .....	12	
Shale .....	4	
Limestone .....	2	
Shale .....	1	
Limestone .....	9	
Sandstone .....	34	
Gray shale .....	125	
Sandstone .....	12	
Gray shale .....	14	6
Coal .....	5	

	Feet Inches	
Fire clay .....	1	6
Limestone .....	1	
White clay .....	2	
Limestone .....	6	6
Gob .....	0	8
Coal, No. 12 .....	0	1
Fire clay .....	1	3
Limestone .....	1	7
Gob .....	2	6
Coal, No. 11 .....	5	6
Fire clay .....	0	11
Shale .....	2	
Total .....	244	

Drill hole No. 16, on Mathew Herrin's place, two miles west of Nebo. Elevation of surface, 369 feet. Elevation of No. 9 coal, 11½ feet A. T.

	Feet Inches	
Surface .....	10	
Shale .....	6	
Sandstone .....	11	
Shale .....	7	
Shale and slate .....	3	
Limestone .....	6	6
Shale .....	31	
Sandstone and shale .....	30	
Sandstone .....	4	
Shale .....	45	
Sandstone .....	12	
Gray slate .....	5	
Gray sandstone .....	10	
Blank .....	25	
Shale .....	14	
Sandstone .....	25	
Shale .....	9	6
Coal .....	1	6
Gob .....	1	
Coal .....	4	
Fire clay .....	3	
Shale .....	2	
Limestone .....	7	6
Sandstone .....	5	
Shale .....	2	
Slate .....	2	6

	Feet Inches	
Fire clay .....	0	6
Limestone .....	2	6
Fire clay .....	6	
Shale .....	67	6
Black slate .....	3	
Coal, No. 9 .....	5	6
Total .....	367 6	

Drill hole No. 17, on William Hancock's place, one mile northwest of Earlington. Elevation of surface, 395 feet. Elevation of No. 11 coal, 368 feet. Elevation of No. 9 coal, 279 feet A. T.

	Feet Inches	
Surface .....	3	
Sandstone .....	■	
Clay .....	5	6
Limestone .....	5	6
Gob .....	1	6
Coal, No. 11 .....	6	
Fire clay .....	3	6
Sandstone .....	55	
Shale .....	23	6
Black slate .....	■	
Coal, No. 9 .....	5	
Fire clay .....	12	6
Sandstone .....	12	
Shale .....	39	
Black slate .....	4	6
Coal .....	0	6
Fire clay .....	2	
Limestone .....	4	
Sandstone .....	23	
Shale .....	3	
Sandstone, dark .....	6	
Shale .....	68	6
Black slate .....	6	6
Coal .....	3	
Fire clay .....	5	
Shale .....	3	
Fire clay .....	3	
Sandstone .....	17	
Total .....	329	

Drill hole No. 20, three miles west of Nebo. Elevation of surface, 377 feet. Elevation of No. 9 coal, 15 feet A. T.

	Feet	Inches
Surface .....	18	
Limestone .....	1	
Shale .....	5	
White sandstone. } Madisonville.....	6	
Red shale.....	5	
Limestone.....	6	
Sandy shale .....	25	
Hard blue sandstone .....	50	
Blue sandstone with streaks of dark shale.....	24	
Gray shale, sticky .....	42	
Gray slate .....	18	
Shale .....	15	
Hard sandstone .....	5	
Gray slate .....	10	
Coal, Nebo .....	7	10
Fire clay .....	0	2
Limestone .....	17	6
Lime shale .....	6	6
White sandstone .....	10	
White clay, sticky .....	2	
Blue sandstone .....	50	
Black sandstone .....	6	
Soft white sandstone .....	6	
Light shale .....	3	
Gray slate .....	14	
Black slate .....	4	
Coal, No. 9 .....	5	3
Total .....	362	3

Drill hole No. 21, on Barrett land, three miles north-west of Earlington. Elevation of surface, 456 feet. Elevation of No. 11 coal, 396 feet. Elevation of No. 9 coal, 320 feet A. T.

	Feet	Inches
Surface .....	5	
Shale .....	42	5
Limestone .....	5	5
Gob .....	1	
Coal, No. 11 .....	6	
Fire clay .....	1	2

	Feet	Inches
Rotten rock .....	4	
Shale .....	5	
Shale and sandstone .....	16	
Sandstone .....	6	
Shale .....	16	6
Slate .....	1	6
Shale .....	1	
Slate .....	0	9
Coal, No. 9 .....	5	3
Total .....	136	

Drill hole No. 22, one-half mile west of No. 21. Elevation of surface 409 feet. Elevation of No. 9 coal as shown in 4, 323 feet A. T.

	Feet	Inches
1. Surface .....	9	
2. Sandstone .....	53	
3. Shale .....	18	
4. Slate, shale, sandstone and coal. Place for No. 9 coal .....	6	
5. Fire clay .....	12	
6. Shale .....	49	6
7. Slate .....	9	
8. Fire clay .....	10	
9. Sandstone .....	22	
Total .....	188	6

The driller reports little coal in the above record. In No. 21, one-half mile to the east, the elevation of No. 9 coal was 320 feet. The elevation of four in drill hole No. 22 is 323 feet. It is evident, therefore, that the 6 feet, as shown in four, is the position of No. 9 coal.

Drill hole No. 23, at Compressor shaft, one mile north of Earlington. Elevation of surface, 442 feet. Elevation of No. 11 coal, 418 feet A. T.

	Feet	Inches
Surface .....	11	11
Coal, No. 12 .....	2	
Limestone .....	3	2
Gob .....		6
Coal, No. 11 .....	6	8
Total .....	24	3

Drill hole No. 27, on Owen Helm's farm, one and a half miles west of Nebo. Elevation of surface, 420 feet. Elevation of No. 9 coal, 91 feet A. T.

	Feet	Inches
Surface .....	8	
Limestone, Madisonville .....	10	
Brown sandstone, hard .....	20	
Gray sandstone .....	40	
White sandstone .....	47	
Hard blue sandstone .....	85	
Gray shale .....	7	
Coal .....	6	
Fire clay .....	1	
Gray shale .....	6	
Limestone .....	10	
Coal .....	1	2
Fire clay .....	1	10
Lime shale .....	13	
Soft shale .....	15	
Brown sandstone .....	4	
Gray shale .....	5	
Black sandstone .....	8	
Shale .....	1	
Sandy shale .....	5	
Hard blue sandstone .....	3	
Dark rotten shale .....	14	
Black slate .....	6	8
Coal, No. 9 .....	5	2
Fire clay .....	1	
Shale .....	38	
Limestone .....	2	2
Limestone and sand .....	1	
Total .....	371	

Record of Luton shaft. Elevation of surface, 368 feet. Elevation of No. 9 coal, 261 feet A. T.

	Feet
Surface .....	20
Sandstone .....	33
Shale .....	47
Coal, No. 9 .....	6
Total .....	107

Crook hole, 3,400 feet west of Luton shaft. Elevation of surface, 373 feet. Elevation of No. 9 coal, 312 feet A. T.

	Feet	Inches
Shale .....	56	
Coal, No. 9 .....	5	4
Total .....	61	4

Playl hole, 2,600 feet south of Luton shaft. Elevation of surface, 360 feet. Elevation of No. 9 coal, 287 feet A. T.

	Feet	Inches
Shale .....	64	
Black slate .....	3	
Coal, No. 9 .....	6	6
Total .....	73	6

Given's hole, 3,800 feet east of Luton shaft. Elevation of surface, 356 feet. Elevation of No. 9 coal, 231 feet A. T.

	Feet
Surface .....	16
Coal .....	5
Shale .....	9
Coal .....	2
Limestone .....	8
Soft limestone .....	33
Shale .....	42
Black slate .....	5
Coal, No. 9 .....	5
Total .....	125

Drill hole No. 28, at Smutzer's saw-mill, two miles west of Nebo Station. Elevation of surface, 376 feet. Elevation of No. 9 coal, 174 feet, 6 inches A. T. Log furnished by Edward and Rooney, Providence.

	Feet	Inches
Surface .....	35	
Shale .....	26	
Slate .....	1	6
Shale .....	6	
Coal .....	7	
Fire clay .....	4	
Limestone .....	4	5
Coal, No. 12 .....	2	
Limestone .....	2	
Coal, No. 11 .....	6	6
Fire clay .....	4	
Sandstone .....	66	
Gray shale .....	30	
Black slate .....	2	6
Coal, No. 9 .....	4	6
Total .....	201	6

Test hole 100 feet N. 80° W. of Rose Creek Coal Company's shaft, Coiltown. Elevation of surface, about 430 feet. Elevation of No. 9 coal, 139 A. T. Record taken from Bulletin No. 17, Kentucky Geological Survey.

	Feet	Inches
Surface .....	12	
Soapstone and white sandy shale .....	31	
Light gray sandstone, very coarse .....	83	
Fire clay .....	4	
Hard limestone .....	12	
Shale .....	14	
Coal, No. 12 .....	6	
Fire clay .....	3	
Limestone .....	14	
Slate .....	6	6
Coal, No. 11 .....	6	6
Fire clay .....	2	6
Shale .....	12	
Gray sandstone .....	52	
Dark gray slate .....	22	
Black slate .....	5	
Coal, No. 9 .....	5	6
Total .....	291	

Core record, No. 25, in Tom Scott's horse lot, one-half mile west of Coiltown. Elevation of surface, 424 feet. Elevation of No. 9 coal, 152 feet A. T. Record furnished by Rose Creek Coal Company.

	Feet	Inches
Surface .....	10	
Gray sand .....	38	
Light gray shale .....	10	
White sand .....	62	
Fire clay .....	1	
White sand .....	9	
Coal .....	5	6
Fire clay .....	1	6
Hard limestone .....	9	
Shale .....	1	6
Coal .....	0	9
Fire clay .....	2	6
Blue shale .....	19	
Coal, broken .....	3	6
Fire clay .....	3	
Dark sandy shale .....	13	
Gray sand .....	24	
Dark sandy shale .....	10	
Light gray sand .....	20	9
Dark sandy shale .....	3	
Gray shale .....	11	
Black slate .....	4	
Coal, No. 9 .....	5	
Total .....	272	

Drill hole No. 26, at Copperas Spring, one mile southwest of Coiltown. Elevation of surface, approximately 440 feet. Elevation of No. 9 coal, 267 feet A. T. Record taken from Bulletin No. 17, Kentucky Geological Survey.

	Feet	Inches
Surface .....	8	
Sandstone .....	26	
Coal.....	2	5
Blue band... } No. 12.....	0	11
Coal.....	3	4
Fire clay .....	1	4
Limestone .....	23	

	Feet Inches	
Blue shale .....	13	
Coal, No. 11 .....	2	7
Fire clay .....	2	5
Sandstone .....	57	
Sandy shale .....	10	
Blue shale .....	14	
Black shale .....	4	
Coal, No. 9 .....	4	9
Total .....	172	9

Log of well on Jewell property, west of Nebo. Location not shown on map. Elevation of surface, 434 feet. Elevation of No. 9 coal, 216 feet A. T.

	Feet Inches	
Surface and sand .....	54	
Coal .....	1	
Fire clay .....	6	
Soft, sandy slate .....	21	
Coal, No. 12 .....	4	8
Fire clay .....	2	
Limestone .....	6	4
Slate .....	0	9
Coal, No. 11 .....	4	11
Fire clay .....	3	
Sandy shale .....	12	9
White sandstone .....	53	5
Gray sandy shale .....	8	
Gray sandy slate .....	29	
Black slate .....	2	
Coal, No. 9 .....	4	9
Total .....	218	7

Log of well 1,000 feet south of well on Jewell property. Elevation of surface, 432 feet. Elevation of No. 9 coal, 288 feet A. T.

	Feet Inches	
Surface .....	15	
Coal .....	2	7
Fire clay .....	2	
Limestone .....	7	
Light shale .....	1	7
Coal .....	4	3

	Feet Inches	
Fire clay .....	2	
Shaly sandstone .....	2	
Gray sandstone .....	47	
Gray slate .....	3	
Gray sandstone .....	5	
Shaly slate .....	1	
Sandy shale .....	20	6
Gray shale .....	13	
Black slate .....	1	
Coal, No. 9 .....	5	2
Fire clay .....	12	1
Total .....	144	2

Log of Reinecke shaft, Madisonville. Elevation of surface, about 424 feet. Elevation of No. 11 coal, 166 feet A. T. Elevation of No. 9 coal, 61 feet A. T. Record taken from Bulletin No. 17, Kentucky Geological Survey.

	Feet Inches	
Red clay .....	18	6
Red sandstone, water bearing .....	3	
Blue sandstone .....	1	6
Blue limestone .....	4	6
Clay .....	2	4
Limestone .....	0	10
Blue fire clay .....	6	6
Red sandstone .....	10	
Red clay .....	13	
Limestone, water in seams .....	4	
Soapstone .....	18	
Blue sandstone .....	98	
Black soft slate .....	20	
Coal .....	2	4
Fire clay .....	3	
Red sandstone .....	6	
Black slate .....	26	
Limestone .....	1	7
Coal, No. 12 .....	4	6
Fire clay .....	0	10
Blue limestone .....	6	
Clod .....	0	6
Black slate .....	0	10
Coal, No. 11 .....	6	6
Fire clay .....	0	11
Limestone .....	1	

	Feet	Inches
Red sandstone .....	60	
Coal .....	1	6
Red sandstone .....	14	
Blue slate .....	22	
Coal, No. 9 .....	5	4
Total .....	363	

Drill record of well on Miss Kate Greer's place, near city limits of Madisonville. Record furnished by Coil Coal Company, of Madisonville.

	Feet	Inches
Surface .....	10	
Gravel .....	5	
Shale .....	2	
Limestone .....	8	
Shale .....	1	
Limestone .....	7	
Clay .....	13	6
Limestone .....	6	
Shale .....	7	
Limestone .....	5	
Shale .....	16	
Sandstone .....	1	
Shale .....	10	
Sandstone .....	10	
Sandy shale .....	6	
Sandstone .....	5	
Shale .....	3	
Sandstone .....	7	
Shale .....	98	
Coal .....	1	6
Fire clay .....	5	6
Lime and clay .....	8	
Shale .....	11	
Lime and shale .....	2	6
Coal, No. 12 .....	3	6
Fire clay .....	0	6
Limestone .....	3	
Black slate .....	0	6
Coal, No. 11 .....	6	6
Fire clay .....	1	
Total .....	262	

Well of Spring Lake Ice Company, near railroad station, Madisonville. Elevation of surface, about 470 feet. Depth to bottom of No. 9 coal, 355 feet. Elevation of No. 9 coal, 115 A. T.

	Feet	Inches
Surface .....	10	
Limestone and sandstone .....	75	
Shale .....	108	
Sandstone, white .....	15	
Shale .....	15	
Limestone .....	15	
Coal, No. 12 .....	1	6
Fire clay .....	5	
Black slate .....	5	
Coal, No. 11 .....	7	6
Fire clay .....	5	
Sandstone, black .....	10	
Shale .....	8	
Sandstone, black .....	10	
Shale .....	5	
Sandstone, white .....	40	
Black slate .....	15	
Coal, No. 9 .....	5	
White shale and white sandstone .....	52	
White slate .....	33	
Sandstone, white .....	30	
White slate .....	10	
Black slate .....	20	
Sandstone, white, water bearing .....	45	
Sandstone, black .....	2	
Coal .....	3	
Sandstone, white .....	2	
Total .....	582	

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**THE ECONOMIC GEOLOGY OF  
A PORTION OF EDMONSON  
AND GRAYSON COUNTIES**

**BY**

**J. OWEN BRYANT**

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## TABLE OF CONTENTS.

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	Page
Location .....	159
Topography .....	159
Soils .....	160
General Geology .....	163
Pennsylvanian .....	165
Structure .....	167
Economic Geology .....	170
Coals .....	170
Asphalt Rock .....	189
Clays .....	203
Marls .....	207
Sand and Gravel .....	208
Iron Ore .....	209
Limestone .....	211
Oil and Gas .....	212
Mineral Water .....	213
Transportation .....	214
Summary .....	214

## THE ECONOMIC GEOLOGY OF A PORTION OF EDMONSON AND GRAYSON COUNTIES.

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### LOCATION.

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The region covered by this report is situated in the south central part of Grayson County and the north central part of Edmonson County. It is bounded on the south by Green River, on the west by Bear Creek and on the east by the watershed between the Nolin and Green River waters in what is termed the "Fork" district and farther to the north by the watershed between Rock Creek and Barton's Run, both of which flow into Nolin River from the north. The northern boundary is for all practical purposes, the Illinois Central Railroad from Leitchfield to Clarkson.

### TOPOGRAPHY.

The entire region may be considered as an elevated plain, rising about 830 feet above sea level. There are a few knobs rising much higher than the average level of the plain, but their area is small, and they are of little interest except as land marks.

The plain has been so dissected by streams that it is now little more than a series of ramifying ridges branching from the main watershed and separated from each other by deep and relatively narrow valleys.

The ends of these ridges have commenced to recede slightly and are, therefore, somewhat lower than the tops of the main ridges, which are, in some places, comparatively broad plateaus and in other places amount to little more than a crest scarcely wide enough to accommodate a highway. In time, these narrow ridges, at present joining the broader flats, will have been cut through by erosion, and the high land will become a series of

plateaus with sags between them. The valleys of all the smaller streams are deep and narrow. In many places there are vertical cliffs over 100 feet high, producing some of the most picturesque scenery the writer has ever seen. The valleys of the two main streams, Bear Creek and Nolin River, which bring the run-off from almost the entire region into Green River, are also comparatively narrow and deep. Here and there in their courses, however, are found small areas of river-bottom land, which is flooded during high water and is being built up by the products of erosion during the flood season. Most of these bottoms are now under cultivation.

### STREAMS.

The streams of the region carry little water at their normal stages. The country drains so quickly that a large percentage of the total run-off finds its way into Green River shortly after its deposition, causing a temporary increase in the flow of the streams many times the volume of the normal flow.

Many of the streams have sufficient fall to provide water power, if the water could be ponded in large reservoirs, but the country rocks are so porous and have been so fractured that it is doubtful if a reservoir could be constructed which would answer all the requirements for power purposes on any of the streams.

**WATER SUPPLY OTHER THAN STREAMS.**—There are numerous springs in this region, some of which are said to have medicinal or curative properties. The most famous of these are the Grayson Springs, which are treated of in detail in an early report on the mineral waters of the State. These springs issue sulphur water and hydrogen sulphide. There are numerous springs furnishing chalybeate waters, especially along the horizon of the base of the Bee Spring sandstone, and also at the base of the thick conglomerate. These waters will be treated in detail later on.

### SOILS.

The soils of the region consist of the residual material from the breaking down of the sedimentary rocks combined with such humus as is naturally produced in

a country which yields a heavy growth of mixed hard woods.

As the three main divisions of sedimentary rocks (shales, sandstones and limestones) are here represented we find all gradations from a pure clay to a pure sand.

Of the two main classes of soils—sedimentary and transported—the former predominates. The soils capping the sandstones and conglomerate, being for the most part composed of the material from these formations, are essentially sandy, though locally we find areas which contain considerable clay resulting from the breaking down of the occasional interbedded clays and shales.

The soils overlying the limestones are nearly all transported, partly for the reason that most of the limestone areas are near the bottom of the valleys and are soon covered, where opportunity offers, by alluvial soil and partly because the marls and shales wash down and cover the lower portion of the region with fine silt mixed with products of erosion of the sandstones and conglomerates, producing the richest soils in the region. Most of the alluvial soils in the valleys are now becoming poorer on account of the increase in sand which is brought down from the hills now under cultivation, which were formerly covered by a dense growth of timber and other vegetation, and which, when so covered, yielded a comparatively small amount of material to erosive agencies.

Wherever a clay soil is found resting upon a porous stratum of any kind, it is usually highly productive, having an opportunity to dry out, and by proper cultivation become warm and mellow. On the other hand, such a soil underlain by an impervious stratum of any kind, remains cold and wet and is of little value agriculturally unless artificially drained.

Conversely, a sandy soil underlain by a porous stratum of any kind, dries out too rapidly, and allows the products of decomposing organic material in solution to pass beyond the reach of the roots of an ordinary crop, while the same soil, if underlain by an impervious stratum, retains much of the soluble material which is of benefit to plant life.

All of these conditions occur locally in this district

and control to a great extent the agricultural value of the land.

The natural vegetation of the district is that of a typical hardwood district, the occurrence of conifers being local and of slight importance.

Much of the region is already deforested and the remaining timber will soon be gone, with the possible exception of such woods as are not used in the manufacture of ties.

The principal crops are corn, wheat and tobacco, alternated from time to time as the soil shows signs of fatigue. There is a large amount of fertilizer used, and its use will have to be increased unless an effort is put forth to enrich the soil by natural methods or to rest it by proper rotation of crops.

Very little attention has been given to the possibilities of renewing the productive qualities of soils by turning under the crops of nitrogen gathering plants. A clearing is made and corn, wheat and tobacco are raised continuously until the land refuses to produce a crop of either worth gathering, when a new clearing is made and cropped.

## GENERAL GEOLOGY.

There are two main divisions made in the geological formations of this region:

- A. Pennsylvanian.
- B. Mississippian.
  - 1. Chester Group.
  - 2. St. Louis Limestone.

It will be noted that the lower formation has been sub-divided into two members. These formations will be treated in the order of their succession.

THE ST. LOUIS LIMESTONES.—This formation does not come to the surface over any great area in this section, and its economic value in this district is, therefore, relatively slight as compared with that of the overlying strata, and no detailed description of it will be given in this paper.

THE CHESTER GROUP.—This group is composed of alternated sandstones, shales and limestones of varying thickness and characteristics.

In the northern part of the district we find a thickness of over one hundred feet of calcareous sandstones and shales, interbedded with marls and limestones, the marls being quite conspicuous because of their colors, thick strata of green and red marls showing in many places just below a thin bedded limestone, which is highly fossiliferous and which for convenience will hereafter be referred to as the "fossil" rock. This limestone is practically at the top of the Chester Group in this section, being overlain unconformably by the sandstones and shales of the Pennsylvanian. It is composed, in many places, almost entirely of remains of crinoids, brachiopods and bryozoa. A good cross section of the upper part of the Chester Group may be seen at the Cedar Knob, about one and one-half miles below Grayson Springs.

As we go southward the character of the Chester Group changes, and when we reach Mill Branch, on the west side of the district and Dismal Creek, on the east side, we find the conspicuous red and green marls have thinned out and practically disappeared. They show locally in some places, but do not constitute a well

marked horizon, as they do in the northern end of the district.

The other strata of thin bedded shales, sandstones and limestones have also changed in character, becoming thicker and more massive and the sandstones seem to have lost much of their lime, while the limestones have increased in content of silica. The shales also have increased in density, but not in thickness, and their color is somewhat darker.

These conditions continue down to the southern boundary of the district.

A thin seam of coal is seen in places in the Chester Group. Sometimes it is found buried under nearly thirty feet of Chester rocks and again it will be found directly beneath the conglomerate, which is the lowest member of the Pennsylvanian.

This variance is due to the unconformity caused by the removal of the upper part of the Chester by the rapid currents which deposited the conglomerate, the rocks above this coal being partially or wholly removed in different places.

This Chester coal is capped by a thin shale and underlain by a fire clay about two inches thick, which in turn is underlain by a thin dark blue shale. Both the shale above the coal and the coal itself carries considerable iron sulphide.

The thickness of the coal varies from two to twelve inches. This precludes the possibility of this formation having any economic value.

This coal may be seen in the limestone on the north side of Green River opposite Brownsville, and a little up stream, occurring there near the base of the cliffs. It has been dug in former years for smithing purposes, but only to a very limited extent.

The marls above mentioned and some of the limestones of the Chester will prove to be the only members having much economic value. These will be treated later.

UNCONFORMITY.—Between the Chester and the base of the coal measures, we find an unconformity marking the period when the Chester group was exposed to erosive agencies and later submerged, allowing the deposition of the conglomerate at the base of the coal measures.

The basal portion of the conglomerate marking this unconformity is composed of pebbles of limestone derived from the Chester Group and quartz pebbles similar to those found in the conglomerate above, all imbedded in a finely crystalline somewhat calcareous matrix.

These conditions are noted in several places, particularly on a short branch flowing into Bear Creek between the mouths of Mill Branch and Napper Branch. The basal conglomerate outcrops in the bed of the stream and along the hillside with a thickness of about five feet.

The same formation also outcrops on a branch of Dismal Creek near Sol. Merideth's farm, its thickness there being about six feet.

THE PENNSYLVANIAN.—The lowest member of the Pennsylvanian, not counting the above mentioned basal conglomerate as it is really merely a marker of the transition from subaerial to subaqueous conditions immediately previous to the commencement of the deposition of the coal measures, is a heavy sandstone conglomerate, lying in massive strata which are complexly cross-bedded.

The entire succession of rocks lying above the Chester is here classed as "Conglomerate" corresponding in position to what has been called the Conglomerate series found in the eastern coal fields where the total thickness of this formation increases to a thousand feet or more.

This conglomerate in this district is divisible into several members.

- a. The thick pebbly conglomerate at the base.
- b. The shales and coal of the Nolin coal horizon.
- c. The Bee Spring Sandstone, which is a massive sandstone containing pebbles in some cases.
- d. A series of thin shaly sandstones, shales and clays containing a thin coal and some iron ores.

These divisions will be described in detail in their regular order.

The sand composing the matrix of the lower conglomerate is coarse in grain and much water-worn. The pebbles are of almost pure quartz, well rounded and ranging in size from a sand grain up to nearly two inches

in diameter. By far the majority of the pebbles are about one-half inch in diameter.

This formation is thin and contains few pebbles in the northern end of the district, but as we go southward we find it thickening rapidly, an exposure opposite the mouth of Dismal Creek, known as Dismal rock, showing a thickness of one hundred and thirty feet. From this point southward we find the thickness varying from just a few feet to fifty and one hundred feet.

This rapid increase in the thickness of this formation and the equally rapid local variations in its thickness are all downward, and are a part of the great general unconformity between the Chester and the overlying Pottsville which seems to extend over all of the Western Coalfield, the rapid currents of water eroding the Chester rocks and cutting deep channels in places, these channels being then filled with the coarse water-worn sand and pebbles now forming the massive conglomerate cliffs. Places can be seen now where the pebbly conglomerate, over one hundred feet thick, is replaced in a short distance by an equally thick section of Chester rocks, the conglomerate being a filled-in portion of an old channel of which the uneroded Chester rocks formed the bank.

The picturesque scenery along Bylew and Gulf Creeks and also along Green and Nolin Rivers, is due to the resistant qualities of this formation. It stands in many places in cliffs over one hundred feet high, the larger portion of which is composed of the conglomerate resting on the upper measures of the Chester group.

Overlying this conglomerate we find a coal having a varying thickness of shale both above and below it, the shale above being as a rule much thicker than the one below, ranging from ten to thirty feet in thickness. This coal was called the Nolin coal in the reports of the Shaler Survey and this name will be retained for it in this report.

Above the shale which lies over the Nolin coal, we find a series of thin interbedded shales and calcareous sandstones, having a total thickness of from ten to twenty-five feet. Above these we find another coal, much thinner than the Nolin coal, with a thin shale both above

and below; these shales are much darker than the ones occurring with the Nolin coal.

Directly above the shale which covers the second coal we find the Bee Spring sandstone, so named because of its characteristic development in the vicinity of Bee Springs. This formation is a coarse to medium-grained sandstone, the grains of which are well rounded. It shows strong cross-bedding in certain of its massive strata and is occasionally conglomeratic.

This formation is found practically throughout the entire district with the exception of its southern extremity, where it has not yet been recognized. The thickness of this formation varies from a few feet up to over sixty feet, being thicker in the northern end of the district as a rule than in the more southern portion. Its thickness seems to change roughly in accordance with the change in thickness of the lower member of the series, growing thinner as the conglomerate thickens, and vice versa. As mentioned above, in some places this formation shows a tendency to become conglomeratic, but this phase is more or less local and extends over no great areas.

Directly above the Bee Spring sandstone we find evidence of the existence of a very thin coal with a thin shale both above and below. This seam is not more than ten inches thick wherever seen by the writer.

Above the shale which caps this coal, we find a considerable thickness of alternated sandy and clay shales with two thin beds of iron ore occurring in definite horizons.

Above this series of clays and shaly sandstones we find the soil surface, the product of the weathering of adjacent rocks.

The economic importance of the various formations will be taken up separately in later chapters.

STRUCTURE.—All the rocks of this region slope from the northern end of the district toward the south and slightly toward the west until we reach Dismal Creek, where the rocks commence to rise towards the south, thus forming a trough or syncline. According to the levels incorporated in a former report on this district the lowest point in this trough lies somewhere between Dismal and

Pigeon Creeks. The rise towards the south from this point seems to be gentle and quite uniform, while the rise to the north from the same point is marked in several places by sudden changes in grade.

From the general evidence obtained along Bear Creek, we find the axis of this syncline strikes a trifle south of west. The syncline is comparatively shallow and broad.

MINOR FOLDING.—There is considerable evidence of minor folding throughout the district, but the arches are all comparatively low and broad. The strike of the axis of these folds seems to be fairly uniform, its direction being about five degrees south of west.

An arch in the Chester group is seen on Hunting Fork of Rock Creek, just above Snap. A fault occurs here and exposes a cross section of the fold, which is about an eighth of a mile broad. The maximum rise is about eight feet. The axis of this fold strikes five degrees south of west.

Going south along Rock Creek from this point, we find numerous dips to both north and south which may indicate either folding, or faulting, or both. No distinct folds are seen, however, until we get to the forks of Beaver Dam Creek, which flows into Bear Creek. Here we find the crest of a fold which brings the Chester group to the surface in the bed of the creek and later, as we follow down the creek, drops them again below the conglomerate. The Chester group appears again at the mouth of the creek, but this is due to deep cutting rather than folding.

Again, on Green River, we find an arch in the rocks above Thomas Raymer's place, the river here cutting diagonally across the fold. The strike of the axis is eight degrees south of west. This same fold is cut by Bear Creek not far above its mouth, but the arch does not show up so well as on Green River.

FAULTING.—Fault criteria are abundant in this area, but most of the vertical displacements are small, varying from a few inches up to a foot or so. There are, however, several large faults in this district, one occurring at Grayson Springs, which is thoroughly described in a paper treating of that locality in a former report.

Another large fault occurs near Dickey's Mill at the mouth of Conoloway Creek. Longfall Creek empties into Nolin River from the east, opposite the mouth of Conoloway. This stream flows along the line of this fault for a considerable distance near the lower part of its course. It disappears into its bed during low water season not more than three hundred yards from the Nolin River and reappears on the west side of the river in a sink hole which is about one hundred yards from the river bank and the same distance from Conoloway Creek below where it empties into the river. There are other openings than this sink hole, as the waters do not, in a dry season, overflow into the river. In high water the creek flows into Nolin from the east, as it should, and the water from the sink hole then runs into the river from the west. The rim of the sink hole is about fifteen feet above the normal level of the river. That this sink hole is truly an outlet of Longfall is known for the following reason: A quantity of refuse was thrown into the creek near its head some years ago, and the refuse which was later seen issuing from the sink hole was identified as the same material dumped into the creek a short time previously. This sink hole and the subterranean channel are in the fault which occurs here.

At Dickey's Mill, a short distance up Nolin, we find the "fossil rock" about twenty-five feet above the river. On crossing Conoloway, near its mouth, and ascending the hill to the south, we find the fossil rock ninety-five feet above the river, showing that the stratigraphic throw of the fault is seventy feet at least.

Another fault is found near M. Beeler's farm on Rock Creek (two miles and one-half above Snap), where a down throw to the north has cut off the conglomerate, bringing the shales underlying the Nolin coal down to the base of the conglomerate. There was formerly a quarry here where the conglomerate, which was heavily impregnated with asphalt, was obtained for purposes of distillation. The work proceeded up to this fault and then ceased.

This fault strikes about six degrees south of west and dips steeply to the north. The dip was roughly estimated by the writer as 85°. The shales have slumped

over the fault plane so that accurate data was not obtainable.

The folding and faulting of the region are responsible for much of the variation, locally, in character of the soils, bringing unlike strata into close proximity, which, on breaking down under the action of the elements, yields soils having different characteristics. Vegetation is accordingly affected, though not to the same degree. The drainage is largely affected by the faulting and to some extent by the folding. By this is meant, not that the streams are controlled as to direction of their courses, except in the case mentioned above, but that the springs and all outlets for ground waters are controlled as to their position and volume by the major faults of the district and are invariably found to be more numerous in parts of this region which are complexly faulted and fractured.

Structure from an economic point of view will be dealt with as each individual case is being discussed.

### ECONOMIC GEOLOGY.

**COALS.**—As noted previously, there are four coals mentioned as found in this district. The lowest of these occurs in the Chester group. It is thin and high in sulphur and therefore unimportant, except that it helps to denote that the tendency of the time during which the Chester group was laid down was to approach coal producing conditions.

This coal is seen in the base of the cliffs along Green River opposite Brownsville and can be traced down the river to a point about two miles above Bear Creek. From this point on, the rocks dip, bringing the coal horizon below the water level. The thickness of this seam varies from one to ten inches. There is a thin shale both above and below the coal and the horizon is marked by the existence of numerous copperas springs.

This coal was formerly used locally by the owners and a few neighbors for smithing purposes, but it was necessary to hand grade it to free it from sulphur.

The coal which is of the greatest economic value, in this district, lies just above the thick conglomerate which forms the base of the Pottsville and will be known in

this report as the Nolin coal. Where the conglomerate is lacking or nearly so, this coal rests close to the upper strata of the Chester group and frequently directly below the equivalent of the Bee Spring sandstone.

Beginning on Rock Creek we find this coal about three miles southeast of Grayson Springs, on the farm belonging to Geo. Tom Skaggs. The hills in this section of the country are low and the coal is near the surface.

At the base of the section here we find a dense, dark colored shale of unknown thickness, then twenty-seven inches of good coal directly above, then from two to five feet of dense shale much resembling the shale in the floor, then a thin ferriferous sandstone from one inch to eight inches thick, then thin bedded shaly sandstone two to three feet thick, then a thick bedded sandstone extending to the tops of the hills. The maximum thickness of this upper sandstone is about forty feet in this locality.

The depth of the coal ranges from 30 to 45 feet below the crests of the hills. The roof seems strong and firm. In the workings, which consist of an entry about thirty-five feet long at the end of which is a room worked out about eighteen feet square, the roof is supported by short posts and shows no sign of movement either in mass or by local swellings. When struck, it sounded firm with no suggestion of being "windy." The floor is firm and solid, showing no sign of swelling near the base of the posts.

The coal is complexly fractured and breaks up into blocks of good size. When undercut it is easily removed with an ordinary pick, no wedges or powder being necessary.

The bed seems to be practically horizontal here. Whatever dip there may be is very slight and to the north. The bed is twenty-seven inches thick where the work was being done.

One man is working here, having leased the ground. The production is about one hundred bushels per ten-hour day. The product sells at eight cents per bushel at the bank.

The following is an analysis of an air dried sample of this coal:

## Analysis.

Moisture .....	3.37
Volatile matter .....	43.31
Fixed carbon .....	49.77
Ash (gray) .....	3.55
	<hr/>
	100.00
Sulphur .....	1.25
Coke (cellular, friable) .....	53.32

At the head of a small branch of the south prong of Rock Creek, we find the same coal on W. H. Johnson's land just below his house. This is an open cut operation and is located on the northeast side of the dividing ridge between Rock Creek and Conoloway Creek waters. The top of the ridge and its spurs are practically on the same level.

We find here first a heavy blue shale at least twenty feet thick, this shale showing in the branch about one hundred yards below the coal bank. Above this shale we find forty-five feet of thin bedded shaly sandstone, then a dark shale about ten feet thick, then a plastic fire clay from five inches to seven inches thick, then two inches of thin shaly coal, then twenty-seven inches of good coal, then from five to six feet of dense dark blue shale, which deteriorates very rapidly upon exposure, then from six to ten inches of sandstone heavily impregnated with iron oxide, then a massive thick bedded sandstone showing no jointing or faulting, which extends to the top of the ridge, a vertical distance of from thirty-five to forty feet.

The depth of the coal is about forty-five feet at this point. The maximum depth in the immediate neighborhood would not be more than sixty feet. The minimum might be about twenty-five feet. The roof is firm, corresponding closely with that at the Skaggs farm above mentioned. The floor is also firm and solid after the removal of the fire clay. The bed is fractured and breaks easily into block of good size.

The bed seems to dip slightly to the northwest. This dip is just enough to prevent good drainage without cutting into the shale below the fire clay to secure a fall in the water way.

The thickness of the workable bed is now twenty-seven inches, but the thin shaly coal at the bottom may become solid on entering the hill and thus slightly increase this thickness.

There is no sign of coal in the shale lying below this bed down the branch, but a part of its cross section is hidden and could not be easily uncovered.

This bank is about two miles east and south of Peonia. The production is small and for local consumption only.

Following is an analysis of an air dried sample of this coal:

## Analysis

Moisture .....	3.35
Volatile matter .....	41.05
Fixed carbon .....	49.22
Ash (reddish-brown) .....	6.38
	<hr/>
	100.00
Sulphur .....	2.19
Coke (cellular, brittle) .....	55.60

For a distance of about three miles north and east of Anderson's bank the coal can be traced along the slopes. Farther north, however, the coal is more difficult to follow, but occasional traces of it are found in some of the hills.

About one-half mile below the mouth of Rock Creek, on the west side of Nolin River, this same coal was opened on the farm of J. C. Simms, but the opening made years ago is now filled and no measurement nor sample could be taken.

The ridge between Conoloway and Rock Creeks contains this coal down to within about a mile of Nolin River. Near the southern end of the ridge the coal shows well up toward the top of the hills and is bound to be more or less rotten on account of lack of impervious covering.

Coal is seen on Joseph Simms' farm about one-fourth mile northeast of Dickey's Mill School in District No. 10. This outcrop is near the top of a hill above the cultivated land. There is shale of unknown thickness

below it and no fire clay at its base. The coal is thirty inches thick, with a little rotten coal shale above it, then sandstone impregnated with iron oxide and above this a thin layer of sandstone somewhat shaly and thin bedded. The thickness of the latter is not over fifteen feet. The coal seam is not more than twenty-five feet below the top of the hill in which it occurs and not much more than thirty-five feet below the tops of adjacent hills.

The roof is not very compact, being subject to the deteriorating action of surface waters and frost. The cover is too thin to warrant any very dense roof over the property. The floor is fairly solid and will undoubtedly prove to be of good character. The texture of the coal cannot be fairly judged by the outcrop. The bed seems to lie in a practically horizontal plane. The thickness of the seam is thirty inches at outcrop. It may become a trifle thinner on going under the covering.

One-half mile west of the same schoolhouse on Charles Stone's land, there is a coal which is very shaly and rotten. There is no sandstone cap over this deposit, the covering being about twelve feet of rotten shale. There are four openings on this seam close together. At the bottom is a blue shale, then coal immediately above capped by a shale. No sign of the ferriferous sandstone was found here. The seam is about twelve feet below the top of the low hills. The roof is rotten and will prove dangerous if carried in on any moderate sized opening. Stripping would be the best method of mining if the quality of the coal warrants its exploitation. The floor is fairly solid. The texture of the bed cannot well be determined from the outcrop. The bed shows little or no dip. The thickness is twenty-six inches.

On Leck Simms' farm, 300 yards west of the same schoolhouse, we find the same coal under much the same conditions, except that it has a somewhat heavier overburden. It is thirty-six inches thick here and will probably prove to be of fair quality as some bright seams show in the outcrop. The waters rising from it carry considerable copperas. This coal also shows in his well, where the water tastes strongly of copperas.

Just below Arch Constant's house on the head of

Haw Lick Branch of Conoloway Creek, there is an old opening, where coal has been dug. No thickness is known and the workings are now filled.

On the south side of Conoloway on Aaron Scott's land near the head of the Slate Lick Branch, is a coal claimed to be thirty-six inches thick. The face of the coal is not visible here and only a little debris from the old diggings. This coal also occurs on Wm. Van Meter's land below the high cliffs of sandstone. No face is visible but the thickness is claimed to be thirty-six inches.

Coal is reported to have been found on the heads of Gut Lick, Bear and Brewster Branches, as well as on Stewart's and Ony Branches of Conoloway. It undoubtedly exists at its proper horizon on these streams, but the wash from the hills has so covered the outcrop that only a suggestion of the coal shale is found here and there along these streams at the proper level.

Coal shale is seen in several places on Cane Camp Branch, but there are no openings where the deposits can be measured or even examined thoroughly, the outcrop being covered by detritus. The coal undoubtedly exists there and it should be of good quality, as it is well covered and the shales seen were rotten, dense and dark colored.

This coal must certainly underlie the entire ridge between Conoloway Creek and Cane Camp Branch, with the exception of the toe of the ridge near Nolin River, which has been cut down, so that if the coal exists at all it is thinly covered. At the heads of the branches the coal will be found to be covered by from forty to sixty feet of sandstone.

On Davis Branch coal was mined at the time the old furnace was running, about one-half mile northwest of the furnace, which is near the mouth of the branch. This coal is well up on the side of the hill under a heavy capping of sandstone. There is a shale of unknown thickness at the base, then a very thin seam of fire clay not more than two inches thick, then coal thirty-one inches, then four to six inches shaly sandstone, then a heavy layer of massive sandstone forty to sixty feet thick. The depth of the seam at this point is fifty-five feet. The roof is good if the thin shaly sandstone be removed in

mining, otherwise there would always be some bad roof liable to come down. Floor dense blue shale, firm and dry. Texture of bed more or less fractured, but yielding blocks of fair size. The bed dips slightly to the north, not to exceed  $1^{\circ}$  however.

Near the headwaters of Davis Branch we find indications of coal in its proper horizon at practically the same level as the deposit above described. One bank was opened in former years and the coal there is said to be four feet thick. The succession and general conditions are practically the same except that the sandstone capping is considerably thicker at the head of the branch.

The entire ridge between Davis and Cane Camp Branch is underlain by this coal, but much of the region is so covered that the location of the seam does not show plainly. By keeping in the same general horizon however traces of the coal shale can be found along the hillsides in numerous places.

On the south prong of Davis Creek we find near its head a shale indicating the coal horizon. There are no openings in the coal here however.

On Dismal Creek there is an opening called the Tar Lick Bank, where considerable coal is produced for local consumption. The opening is about two miles northeast of Bee Springs. At the bottom is a blue shale about four feet thick, above which we find six inches of plastic fire clay followed by six inches of shaly coal, then thirty-six inches of good coal, then twenty feet light blue shale containing numerous nodular iron concretions, considerable gypsum and iron sulphide, then some thin bedded calcareous sandstone, with the thick massive Bee Spring sandstone capping the hills. The depth of the seam is about sixty feet. The roof if mined under the hill would undoubtedly be fairly solid, but would not be as firm as the dark blue shale roof occurring farther to the north. The floor would be firm and solid as any in the district. The bed is considerably fractured but yields large blocks of coal, much larger than any of the other deposits thus far described. The bed dips to the north at about  $1^{\circ}$ — $30'$ . The total thickness of the coal, including the six inches of shaly coal in the bottom, is forty-two inches. A somewhat greater thickness is said to have been un-

covered, but the above measurement was made where a new face had just been opened.

There is no indication of gas in the seam but the entire seam is more or less thoroughly impregnated with asphalt, from which the bank gets its name. All the major crevices and many of the minute ones are filled with this material. On account of its presence the coal is easily kindled and for this reason is in high favor throughout the neighborhood.

Following is an analysis of an air dried sample of this coal:

Analysis.

Moisture .....	4.81
Volatile matter .....	36.14
Fixed carbon .....	46.45
Ash (illac colored) .....	12.60
	<hr/>
	100.00
Sulphur .....	2.69
Coke (dense) .....	59.05

The high percentage of ash is probably due to the shaly coal near the base.

The coal outcrops here for a considerable distance along the face of the hill and several old openings were seen which are now filled. Following along the hillsides the coal can be traced down one branch, around the point of a ridge and up another, along almost the entire headwaters of this stream.

About one-half mile northeast of Bee Springs there is an old entry called the Knob Lick Bank which is so filled that it could not be examined. The coal here is of the same quality as that of the Tar Lick Bank, with the exception that it does not contain very much of the fluid asphalt.

The Barrett mine, an entry which was driven fifteen hundred feet into the hill, shows good coal at the outcrop. This opening is about one-half mile south and east of Bee Springs. The succession, depth of deposit and general conditions are practically the same as at the Tar Lick Bank, excepting that there is a lack of asphalt in the crevices. The coal shows along the Bee Springs

Branch on Thos. Rich's farm and on surrounding lands where it has been plowed up in the fields on the hillsides.

The Dismal Creek valley has more openings in the coal than any other in the district, principally because there is more opportunity for marketing the coal from this locality.

On Pigeon Creek there is only one opening in the coal and it has long since been filled by the wash in the branch. This opening is on Sam Vincent's land near the head of the south prong of Pigeon. The coal was used in operating a portable mill and for blacksmithing purposes. The opening was made practically in the bed of the branch. The succession, beginning at the bottom, is as follows: Thick conglomerate, then thin interbedded shales and sandy limestones about twenty feet, then coal underlain by a shale, then heavy shale twenty feet, then sandstone seventy-five feet, then clays and iron ores thirty feet. The depth of the seam is from seventy-five to one hundred feet. The roof, which is shale, would be fairly solid, judging from its appearance at the outcrop. The floor is firm, of practically the same character as the roof. The bed of coal does not show any extreme fracturing and is said to have produced blocks of good size. The bed has a slight dip to the north but it is hardly noticeable. The thickness of the bed is said to be forty inches, which includes about eight inches of rotten shaly coal on top of the seam. There seems to be little or no sulphur in this locality. No gas or other inflammable material is found in the seam or in rocks immediately adjacent, but the asphalt shows in sandstones above the shale and some of this material may be found in this coal where it is opened up.

On Pine Creek no outcrop of coal was found and little or no trace of it at the horizon in which it ought to occur. Immediately above the conglomerate we find a shaly sandstone which is more or less calcareous, but no trace of the coal, although there is a trace of the light gray shale above the coal horizon. This is covered by a thin bedded sandstone which corresponds to the Bee Springs formation.

On Indian Creek much the same conditions are found and no coal was seen. On the road to Brownsville

there is a thin coal showing about one and one-half miles north of Green River. This is on the ridge between the head of the south prong of Indian Creek and the head of Limestone Branch which flows into Green River. The coal is rotten and thin and so affected by slump that no reliable data could be derived from it concerning thickness or quality.

On the east prong of Honey Creek, near the head of the stream, we find indications of coal in its proper position, but no thickness could be determined. This is south of the road which leads to the mouth of Bear Creek about a third of a mile.

On Crooked Creek also we find indications of coal in the branches at the head-waters of the stream south of the road from Brownsville to the mouth of Bear Creek. The thickness is not known. The wash shows only a thin, laminated, rotten coal shale highly carbonaceous which, judging from the occurrence in other places, must lie just above the coal itself.

In a hollow, south of this same road, about one-half mile west of Segal, there is a coal twenty-five inches thick overlain by four inches of shaly coal very rotten. This is uncovered by water in a deep gully.

Above this coal we find a shale from fifteen to twenty feet thick, overlain by a sandstone which near its base is conglomeratic, containing quartz pebbles, but this phase soon changes to a thin bedded fine-grained sandstone, pieces from some layers of which are used locally as whetstones. This coal is on J. Alford's land.

On Bullock Branch, which flows into Green River, about one-half mile above the mouth of Bear Creek, there are numerous places where coal shows in the beds of the branches. Coal shows in three of the small branches about half-way up from the mouth of this branch, showing thin bedded sandstones below, then a few feet of shale, then coal, then heavy shale capped by sandstones. No thickness could be determined accurately. The aneroid showed this coal to be sixty feet lower than the coal above mentioned on Alford's place.

Less than an eighth of a mile above this we come to the Toma mine, which is nearly seventy-five feet below the coal on Alford's farm. The succession is practically

as given above. The depth of the seam is about forty feet. The roof is not very firm although it holds up well when properly timbered. The floor is solid and of good character. The seam here is shattered and breaks into small fragments. This is the first coal the writer has seen which exhibits the iridescence known as peacock colors. The dip is to the southwest and amounts to about three and one-half degrees. The thickness is twenty-nine inches, including a one-fourth inch seam of shaly coal, five inches below the top of the seam.

An entry was driven into the hill here for about fifty feet where two headings branch off from it.

The following is an analysis of an air dried sample of this coal:

## Analysis.

Moisture .....	4.23
Volatile matter .....	35.07
Fixed carbon .....	42.42
Ash (red) .....	18.28
	100.00
Sulphur .....	4.37
Coke (cellular) .....	60.70

From this point up Bullock Branch, coal shows in the bed of the stream for a distance of two hundred feet. This is about three hundred yards northeast of the mine above mentioned. The slight bone parting which is noted in the Toma mine shows more strongly here in the creek bed. The thickness of the coal here is approximately thirty inches.

Following up the stream we come to James Jones' farm, one-fourth mile northwest of the Alford's place. Here we find a coal uncovered by recent erosion in a field now under cultivation. This coal is one hundred and thirty feet above the seam at the Toma mine. The dip is here 6° to the southwest. This coal is very sulphury, a cross-section being as follows:

Beginning at the bottom—coal 11 inches, sulphur 1-3 inch, coal 4 inches, sulphur 1-2 inch, coal 9 inches, sulphur 1-2 inch, coal 4 1-2 inches. Total, coal 28 1-2 inches. Total sulphur, which is bright and green, 11-3 inches.

The coal is much shattered, but some of it is bright and would be of good quality were it not for the presence of the sulphur. Over all these coals there is a trace of a thin bed of ferruginous material called iron ore, but it is not of commercial value and cannot be classed as a true ore.

On Gulf Creek we find a coal on the Caney Branch on Buck Self's farm, about one-half mile northeast of Segal. This coal was mined for blacksmithing purposes some years ago, but was dug from the bed of the branch and the workings are now filled. The thickness of the coal is said to be forty inches. Immediately above the coal there is about ten inches of the so-called iron ore, capped by shale about fifteen feet in thickness. This coal shows in a shallow flat and would have to be carried for a distance of several hundred feet before obtaining a sufficiently strong roof to permit underground work.

Three-quarters of a mile west of Segal is a coal bank which the writer had opened for sampling purposes. This opening shows first thin shale, then coal, then heavy shales twenty feet, then sandstones for forty feet. The depth of the seam is fifty to sixty feet. Roof strong and firm blue shale. Floor fairly strong and firm, hard shale. The bed had been shattered by the use of dynamite in former years when worked and the original texture could only be guessed at. That there is some fracturing due to natural causes is certain, but its extent is uncertain. The bed seems to dip slightly to the southwest. Thickness of bed, four inches of shaly coal at the bottom, then twenty-four inches of good coal.

Following is an analysis of an air dried sample of this coal:

## Analysis.

Moisture .....	4.30
Volatile matter .....	31.70
Fixed carbon .....	36.85
Ash (red) .....	27.15
	100.00
Sulphur .....	9.45
Coke (very dense) .....	64.00

One-half mile north and east from here there is coal wash in the bed of the branch and outcropping shales showing the coal horizon distinctly.

A coal is known to exist at the proper horizon in Copperas Branch, which is the next stream above Gulf Creek flowing into Bear Creek. This coal does not show at the surface, but a slight amount of wash and the presence of the heavy blue shale from which issue strong copperas waters is conclusive evidence of the existence of the coal.

Coal is found on Beaver Dam Creek on the White Oak Fork. This is known as the Parsley Bank. The thickness here is said to be thirty-eight inches. The workings are filled and no measurement could be made. The quality of the coal is said to be good with little or no sulphur present.

Coal is seen also on the north fork of the creek near the old Beaver Dam mill site. The thickness is unknown as no work has been done here for a long time.

On Sycamore Creek in a field in the Pool hollow, coal is exposed in a gully made by recent rains. Thirty-one inches of coal shows with shale both above and below. This coal seems to be free from sulphur and not badly shattered.

About a half-mile to the east and a trifle to the south is the Rosanna coal bank which shows thirty-eight inches of coal of good quality and texture. There is sufficient overburden, so that on entering, the dark blue shale in the roof and floor would be firm and easy to handle. The bed seems to dip a trifle to the west in both of these places.

Coal has also been worked on the head of Sycamore Creek, about one-half mile southeast of Bee Springs. The coal obtained is of good quality, but the thickness is not known.

Near the head of Napper's Branch, about 400 yards below Mitchell Vincent's place, coal has been worked in the side of the hill close to the stream. The thickness is reported to be forty inches, all coal, and of quality equal to any in the district. Nothing is to be seen now but the signs of the old work. This is the only place where the coal is positively known to exist on this stream.

On nearly all the smaller branches of Mill Branch, we find indications of coal and in the bed of the main stream about 1 1-2 miles up from its mouth several places where the coal has been worked. There was no opportunity to make measurements. The coal is said to be forty inches thick. It is capped by a shale from twenty to twenty-five feet thick, above which lies the massive sandstone nearly seventy feet thick. Both the floor and roof ought to be good and firm under cover.

On Nell's Fork we find evidence of the presence of coal at its proper horizon in most of the branches toward the head of the creek. In one place on the north prong about 2 1-3 miles northwest of Bee Springs, we find fifty-one inches of coal uncovered in the branch. This coal is underlain by six feet of sandstone and overlain by a dense blue shale.

About 200 yards south along the branch there is a place where the coal has been worked. The thickness is said to be at least forty inches, but the pit is now filled. A strong copperas spring issues from the base of the coal, indicating the presence of considerable sulphur.

Coal is seen in the two head prongs of Shoal Branch capped by a dense blue shale, the lower part of which shows some pebbles of limestone. This shale is covered by from fifty to seventy feet of sandstone. These outcrops are not far apart and about 2 1-2 miles northeast of the mouth of the streams. The thickness of the coal as seen uncovered in the branch is from forty-nine to fifty inches, all coal. Its quality is said to be good, but none has been used for years, so no recent openings could be seen. There is a slight dip to the west, and as this corresponds to the direction of drainage here, there is an ideal opportunity to take advantage of the dip to unwater the workings. The roof and floor should be good here and the thickness of the bed should encourage more work in this vicinity.

Decker's or Saltman's Branch carries coal on all its headwaters. All the diggings are filled, however, and no thickness could be measured. It is claimed to be from thirty-eight to forty inches.

Evidence of coal is seen in the head of Bonedger Branch, the first branch from the mouth on the north side

of the creek. There is also some evidence in Scott Branch which is the next branch up the creek on the same side. Thickness is said to be forty inches.

Coal is also found in the wash of the Flint Rock House Branch, the first branch up from the mouth of the creek on the south side. The thickness is said to be thirty-eight inches, but the workings are now filled.

These coals are capped by a blue shale overlain by a heavy sandstone. There is a conglomeratic stage marking an unconformity between the shale and the overlying sandstone, the latter being slightly conglomeratic at its base in places. The roof and floor ought to be good in this locality. The overburden is from fifty to seventy feet thick.

Coal is seen on the north prong of Sorrel Branch about seventy yards south of the road from Wooligham's store to Bear Creek, the distance from the store being about 3-4 of a mile in a westerly direction. The succession here corresponds closely to that at the Anderson's Bank on Rock Creek, showing a sandstone above a thin shale capping the coal and some sixty feet stratigraphically below the coal a heavy blue shale nearly thirty feet thick. Some thin layers of this coal are cannel coal, but most of them are bituminous. The thickness is said to be twenty inches. This coal has been struck in several wells in this neighborhood and evidently underlies all the main ridges. Traces of this coal are also seen 1-2 mile south of Wooligham's Store but the thickness is not known.

Coal is found on the Stone Coal Branch of Hat Branch, about 1-2 mile northwest of Wooligham's store on John Donner's land. Here a bank is opened showing twelve to fourteen inches of bright coal, below which is five to seven inches of thin, shaly, rotten coal. No sulphur and little copperas was seen here. The coal was too much shattered to yield a cabinet specimen which would stand transportation and not thick enough to warrant a sample being taken for analysis. This same coal outcrops a third of a mile north of this bank on the north prong of this branch. It was worked some years ago, but the workings are now filled. The thickness is said to be about eighteen to twenty inches, with quality corresponding to that of the coal in the first bank mentioned.

### ON THE EAST SIDE OF NOLIN.

The Nolin coal, already described, is the only workable seam of coal known in this district. No coal is seen until we get up to the ridge between Second and Bylew Creeks, where a thin coal is found about sixty rods northeast of the store at Ollie. This coal is said to be fourteen inches thick. It is in thin layers and much fractured, the fractures being filled with asphalt. The area underlain by this coal is small as it is not far below the top of the ridge and it is cut off by a fault on its south side not more than sixty rods from the above mentioned opening. The down throw of the fault is on the north side, showing the coal against the conglomerate at the fault.

On Joe Jack Merideth's place on the Sugar Camp branch of Brier Creek, which branch is the second one entering Brier from the south, commencing at the mouth of Brier Creek, we find a coal bank which is now filled, but which at one time yielded a considerable amount of coal. The seam is said to be twenty-six inches thick. This bank is one-fourth mile northeast of Merideth's house and about three-fourth mile from where the Sugar Camp branch empties into Brier.

Rounding the headwaters of Brier Creek we find coal on Sam Hicks' place underlying the ridge between the waters of Cub or Longfall Creek, which flows into Nolin River, and the waters of Wolf Creek, which flow into Green River. This bank is one mile northeast of Straw. The opening is now filled, but the thickness is eighteen inches, all coal, with an overburden of about thirty-five feet.

Coal is also found on Sherman Dennison's farm, about one mile north of Straw. The thickness is eighteen inches and the overburden is thin here also.

Coal is also found on John Higden's place on a small branch called Higden's Branch, which flows into Nolin River above the mouth of Longfall. This coal has been opened but the workings are now filled. The writer was able to measure twenty-eight inches of coal, but a strong flow of water prevented getting to the bottom. The thickness claimed is forty-four inches. It outcrops on both sides of the branch and can be traced for a con-

siderable distance by the slump of the overlying shale. This coal is bright and of as good a quality as any in the district. It is overlain by a heavy, dense blue shale and the entire overburden is from forty to sixty feet thick. The dip is slightly to the north.

On Elizabeth Carroll's land are two openings on this same seam, but both are now filled. The thickness is said to be thirty-six inches. This is at the head of a branch of Longfall about two and one-half miles up from the mouth of the creek.

The two upper coals of this region are of no commercial importance and hence have little or no place in an economic report of the region, since they are not readily confused with the main Nolin coal. Very few outcrops of these coals are known and no attempt has been made to locate them definitely.

#### MINING THE COAL.

The prime considerations in mining any coal seam are:

1. The thickness of the seam.
2. Character of roof and floor.
3. Dip of the seam.
4. Amount of water to be dealt with.

The only workable seam of coal in this region is the Nolin coal. Its thickness varies from twenty-two inches to at least fifty inches, with an average thickness over the whole field of about thirty-four inches. The roof and floor are good and firm in most cases, especially in that part of the region in which the thickest and best coal lies. Where the coal is thin, in the southern part of the district, it shows much fracturing and this fracturing may extend into the roof and floor, which would cause trouble in mining operations. The dip of the major portion of the seam is relatively slight, averaging less than one degree. At the northern and southern ends of the district we find marked dips, but the coal here is much thinner than the average and offers few inducements to operators when thicker coal under more favorable conditions can be obtained. The direction of the dip is primarily

governed by the broad synclinal basin in which it lies, but faulting and minor folding combined have modified it to a considerable degree. The region is so cut by stream valleys that it will be found a comparatively simple matter to drive the main headings and entries either up the dip of the bed or along its strike, thus avoiding the expenditure of unnecessary power in haulage and providing natural drainage. The amount of water to be taken care of would be considerable in some places, but the dip of the seam will take care of it if a proper system of ditching be used. The thickness of the seam and the condition and character of the roof and floor make this coal adaptable to either advancing or retreating long wall methods of mining.

The latter might be found to be preferable in that the power and labor costs of production decrease with the increasing life of the mine, which would tend to offset the effect of breakage, repairs, and replacement of both surface and underground equipment, together with interest on the investment annually compounded which increases rapidly as the time of operation is extended.

## ASPHALT OR "BLACK" ROCK.

At a point on Rock Creek, two and a half miles above Snap, the conglomerate sandstone is thoroughly impregnated with asphalt. At one time this rock was mined, conveyed to a small branch where water could be easily obtained and the asphalt distilled from it. Over eighty barrels are said to have been produced.

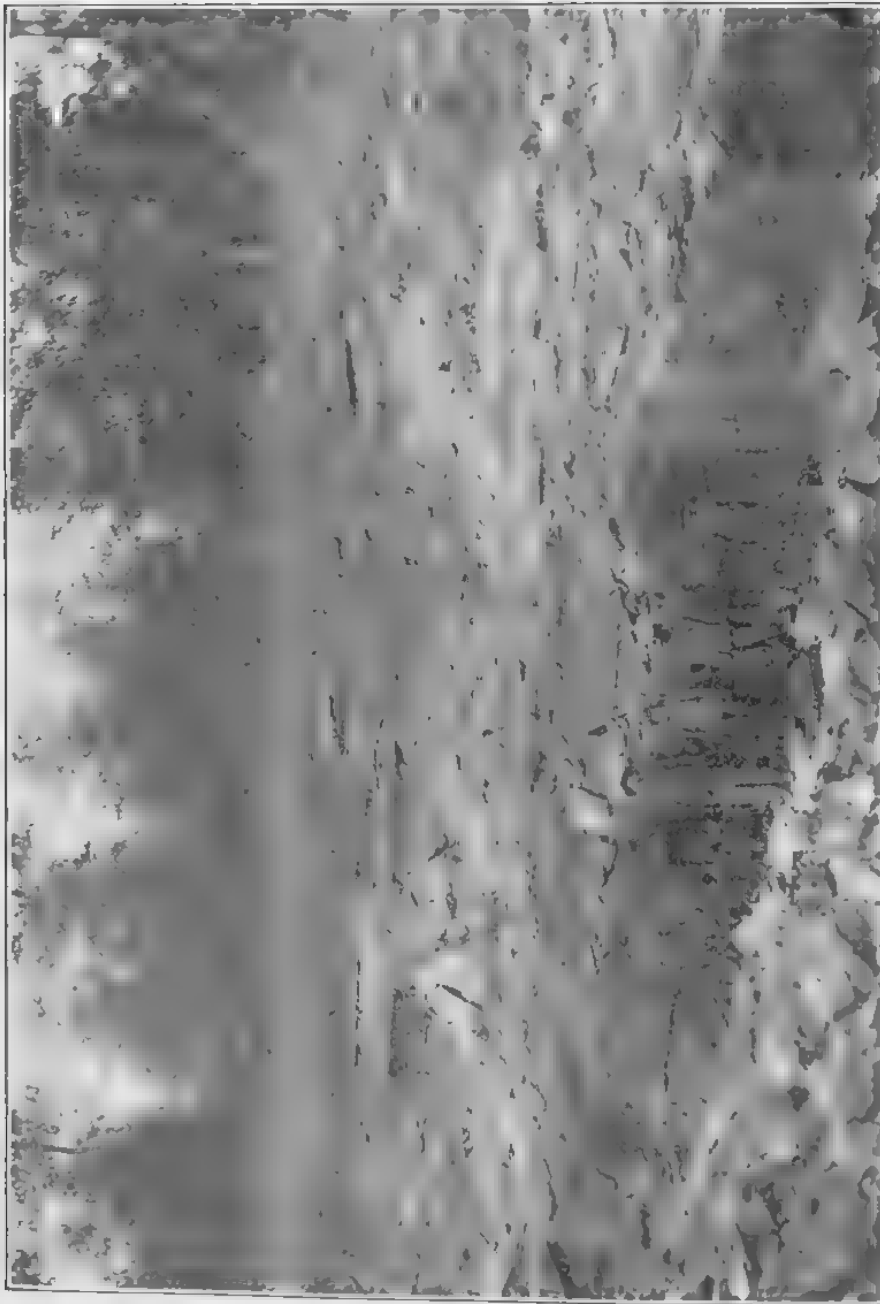
Following down the creek there is evidence of the presence of asphalt in the ridges on each side of the stream. The deposits where seen were comparatively thin, ranging from four to twelve feet in thickness. The impregnation seemed to be practically perfect in that all the pore space of the rock seemed filled with the asphalt. The sandstone forming the main ridge between Somers Branch of Rock Creek and Bridge Branch shows impregnation by asphalt in several places. From fifteen to thirty feet of rock rich in asphalt shows just back of the Van Meter schoolhouse on Rock Creek waters. This is nearly eighty feet below the top of the ridge. Asphalt shows in the well at this schoolhouse also, the top of the impregnated stratum being considerably higher than the outcrops in the branch.

The main ridge between Rock Creek and Conoloway Creek carries asphalt until within about two miles of Nolin River. From this point on to the river the rocks which the asphalt can penetrate most easily have been removed. Patches of asphalt are seen in nearly all the ridges lying between the branches of Rock Creek flowing from the north and west. Some asphalt is reported on the east side of the creek, but what was seen is scattering and not very thick.

On J. N. Alvy's farm asphalt is found on the head of a small branch flowing into the Dry Branch of Conoloway. This rock shows a thickness of from twenty to thirty feet. A few barrels of asphalt were distilled from the rock here some years ago. The impregnation seems to be complete.

At Arch Constants, about one mile southwest of Dickey's Mill schoolhouse, District No. 10, there is a thickness of twelve feet of rich asphalt rock.

At Alec VanMeter's farm, in a spring running back of the house, some asphalt rock shows. The thickness



Asphalt Rock Mine Near Green River.

here is inconsiderable, but it may become much greater on entering the hill. Reports of several places where asphalt is issuing from the rock forming what are locally termed "Tar Springs" seem to indicate that the material is still active in this region and may be found in any of the higher ridges on either side of Conoloway Creek. Some asphalt is found a short distance below the mouth of Conoloway near the bank of Nolin River.

On Cane Camp Branch we find some black rock, which is the local term for any formation showing impregnation by asphalt, in a knob about one half mile below the mouth of the creek near the banks of Nolin. This is a small discontinuous patch of no great richness or thickness.

Black rock in the ridges on each side of Davis Branch is seen in places, but it is not so rich nor continuous, at the surface at least, as the deposits elsewhere seen. At the head of the south prong of Davis Branch there is a deposit of rich black rock which shows a thickness of at least fifty feet by the aneroid. This rock is exposed in the bed of the branch and shows no dip, so the aneroid readings give approximately the true thickness at the surface of the impregnated strata.

About three-fourths of a mile down Nolin River from the mouth of Davis Branch are cliffs containing about thirty-five feet of black rock. The rock here is a thin bedded shaly sandstone having much less pore space in the rock itself than the more massive strata usually have. The impregnation seems to have been as complete as possible considering this fact, but the rock will be found to contain much less total asphalt than in many of the other places above mentioned.

Black rock is said to show at the head of Negro Creek, but the writer saw none in passing through that locality. The rocks in nearly all the higher ridges at the head waters of Dismal Creek show impregnation to a greater or less degree.

On one branch, about one-quarter of a mile west and north of the Tar Lick coal bank there is a vertical thickness of nearly seventy-five feet, barometric measurement, exposed in the bed of a branch. There are four places here where the "tar" issues from the rocks con-

tinually. This is the thickest and richest black rock seen in the entire district. Its total extent here is unknown, but it is certain that the impregnation is practically continuous to a considerable extent throughout the ridges between the headwaters of Dismal and Davis Creeks.

South of the mouth of Pigeon Creek, on the banks of Nolin River, there is a stratum of more or less conglomeratic sandstone near the crest of the hill, which is heavily impregnated with asphalt. This deposit is from fifteen to eighteen feet thick where it outcrops. Topographically and stratigraphically above this stratum we find a fine grained sandstone completely impregnated with asphalt in the hills at the head of Pigeon Creek. It is also found in the well at Sam Vincent's, where the owner reports a thickness of forty feet. The "tar" runs out of the rock in the well and at times clogs the well bucket.

Opposite Van Harrison's much the same conditions are found, and near by, at the schoolhouse, black rock cuttings are seen by the well. This is in the same horizon as the black rock at Vincent's.

On the head of Pine Creek there is a relatively thin stratum of the conglomerate near the top of the cliffs, which is impregnated with asphalt. Its thickness and richness are somewhat less than on Pine Creek, but both may increase on entering the hill.

On Indian Creek, at the head of the north fork, there is a deposit of black rock which has been worked to a considerable extent in the past. This working is known as the Hatch mine. The impregnated stratum is close to the base of the Bee Springs sandstone and shows some conglomeratic phases and much cross bedding. The thickness of the deposit where opened is twelve feet. The rock is rich and a freshly broken sample can be crushed in the hand. This rock, after the asphalt is burned out, is a pure white sand, with little or no cementing material.

Following along Green River we find a series of thin bedded limestones in the Chester group slightly impregnated with asphalt in various places, as on the hill in the road leading to the ferry at Brownsville and also on Limestone Creek on the land belonging to Roscoe Vincent. The ridge at the head of the streams which flow directly into Green River, shows black rock in a number

of places, the most important of which is at the asphalt mine owned by the Wadsworth Stone and Paving Company, where extensive operations have been carried on for years. The rock is quarried and conveyed to a plant on the banks of Green River, where it is crushed and either shipped in the crude form or made into a mastic which is briquetted and shipped.\*

Some black rock is also seen on the top of the cliffs along Green River at Thos. Raymer's farm about two and one-half miles down the river from the asphalt plant. No great thickness, however, is seen in this locality.

The ridge between Bullock Branch and Gulf Creek seems to contain but little of this material. On the north side of Gulf Creek on the very edge of the highest cliffs less than one-half mile from the mouth of the stream, there is a thickness of twelve feet of black rock. This material also shows in a small branch which flows into the north prong of Gulf Creek.

At the head of Copperas Branch a little black rock is seen, but it is neither very rich nor thick at the outcrop. Both the quality and quantity might easily increase on going into the hill.

On Beaver Dam Creek there is an exposure of black rock on the Garrett Vincent place near the mouth of the creek on the north bank. The thickness is about fifteen feet, capped by about thirty feet of sandstone.

It is also seen in the hill south of the forks of this stream, but is so covered no thickness could be determined. It undoubtedly extends throughout the ridge between this stream and Gulf Creek and also through the dividing ridge between Beaver Dam and Sycamore Creeks. On the headwaters of the latter and extending down to the mouth of Rube's Branch, which is the north prong of the creek, there are several places where black rock has been found. The richest seen was about one-half mile east of D. W. Musick's place, where a trench has been made in this material by former prospectors.

From the south side of the ridge between Sycamore Creek and Napper's Branch few traces of black rock are found until we reach the north prong of Napper, where there is a cliff showing this material from eighteen to

\*See Volume 1., 4th Series, Kentucky Geological Survey.

thirty-two feet thick, resting not far above the top of the Chester group. None of this rock is as rich in asphalt as the material found on Dismal or Davis Creeks, though it may prove just as rich on entering the hill where the material has not had the same opportunity to dry out as it has had at the outcrop.

On Mill Branch no black rock is seen and none is known to settlers in that neighborhood.

On Nell's Fork likewise no outcrop of black rock was seen, it appearing that the impregnation has not extended to the west side of the main watershed between Nolin River and Bear Creek.

The black rock on Shoal Branch is merely a stain in thin patches here and there. It does not seem continuous nor is it anywhere rich enough to warrant much investigation until further deposits are known to exist in this vicinity. It is possible that drilling might disclose a more thorough impregnation of the rocks in the main ridges here.

On Decker's Branch no black rock is seen nor was any reported by settlers.

Black rock shows in the road south of Wooligham's store on Sorrel Branch waters and also in the road west of the same store at a distance of about one-half mile in each case. It was also struck in a well on John Donner's land just opposite the store building. The thickness varies from ten to twenty feet, but it is not rich, the impregnation being nothing more than a heavy stain. It seems here to be in small isolated patches near the zones of greatest fracturing.

The low hills and ridges between Sorrel and Hat Branches are certainly underlain by a thin stratum of black rock which has been struck in several wells in that locality. Some of it at least is rich, "tar" having been found in the buckets used in the wells.

About one-half mile from the mouth of Nolin River there is a thin stratum of black rock in the bed of a branch, lying just above the Chester group. A little tar has issued from this rock showing continual activity. The thickness is about six feet.

Crossing Nolin River some black rock shows near the head of First Creek, but it is comparatively thin and

low. Near the top of the ridge between First and Second Creeks some black rock is seen in a thin sandstone corresponding to the Bee Springs formation. At no place was it seen more than fifteen feet thick. Continuous activity is indicated by the tar running out of some of the crevices. These outcrops are found at the heads of the smaller branches, some of the richest of these deposits showing in the top of the conglomerate, which is thick here. On the hill at the base of which head Cub Creek, which flows southeast into Green River, Second Creek, First Creek and Bylew Creek, which flow into Nolin River from the east and north, there is a thin capping of sandstone over the conglomerate which shows asphalt in a number of places, the more notable of which are at Ollie. There is rich black rock in the well at the store here, and the tar has to be strained out of the water to render the latter fit for domestic use. The waters occurring in wells showing black rock are unusually sweet and the best in the entire district after the tar is removed from them. Just back of the store, about twenty rods, this rock outcrops on the hillside with a thickness of from twelve to twenty-five feet. About forty yards south of the store there is a place where the tar has issued through the soil. This tar spring is on the same level as a coal bank about forty rods to the northeast, which also shows much tar in the crevices in the coal. The overburden here is not more than twenty-five feet thick at any place.

There is a crevice from which a small amount of tar has issued about one-fourth of a mile southwest of Bib Pridie's place, about two miles north of Ollie. There is no stain of asphalt in the wall rock of the crevice on either side. There is no black rock showing in the well at Frank Rich's farm, a short distance northeast of here. This is a bored well two hundred and forty feet deep.

On the accompanying map is shown by a dotted line, the area in which black rock is likely to be found, judging from the data at hand. It is to be understood that not all of this area shows black rock outcrops, but the impregnation is likely to be found extending some distance beyond where outcrops are found as the formation is usually conducive to extensive lateral as well as vertical

flow. The total area in which the black rock may be found in this region is approximately eighty square miles. No definite acreage of the known deposits showing at the surface is known, nor could it be determined without the expenditure of considerable time and money in prospecting. Areas in which the black rock actually show would make a large acreage, as in places it can be traced along the sides of the hills for from eighty rods to over one-half mile, without a break. The quantity of material available cannot be estimated even roughly, but it is certain that a vast tonnage could be produced and that at a comparatively low cost, as in most cases there is ample opportunity for quarrying the material directly with a very small amount of work in removing the overburden. By the time these quarries are worked back to the hills, sufficient prospecting could have been done to determine the best method of mining the material under the ridges which may be covered by a relatively heavy overburden.

#### THE ORIGIN OF THE BLACK ROCK.

Scientists of the present day are divided in their opinions as to the exact derivation of the bitumens but are practically unanimous in the opinion that their source was mainly organic material, either animal or vegetable or both.

By complex chemical reactions, in which sulphur seems to have taken an important part, the asphalt under discussion has probably been derived from either or both of these sources. No discussion as to the origin of the asphalt will be attempted in this paper, as a strictly economic report has to deal with the material which is known to exist and its uses rather than with its derivation, unless a knowledge of its derivation is necessary for the economical development of the properties. That this asphalt does exist and that it may be obtained in large quantities we know. It remains to determine the uses to which it may be put in the commercial world.

## OCCURRENCE.

The black rock does not occur at any definite horizon nor is it continuous at any one horizon throughout the district as is the coal. It is the result of an invasion by the asphalt in a more or less fluid state. Following the fissures in the formations it has pushed its way wherever there was an easy passage, following the lines of least resistance. In passing through a dense limestone or a shale, little or no impregnation of the surrounding rock was possible, but in a porous limestone or sandstone or in formations such as the thin bedded shaly limestones and sandstones and even in the seams of coal where bedding planes joints exist it has forced its way in every direction.

The most characteristic development of rich black rock is, of course, to be looked for in a relatively coarse-grained massive sandstone or conglomerate where there is ample opportunity for relief from the pressure back of it, resulting in a filling of the pore space of these rocks and including the fractures and openings. These rocks then become reservoirs for retaining this material, just as oil sands are reservoirs for retaining petroleum.

Both the Bee Springs sandstone and the heavy conglomerate below it are complexly cross-bedded and there has been considerable cementation along the horizontal bedding planes and the planes of cross-bedding as well. This cementation has a tendency to check the flow of the asphalt through the rock and causes irregularities in the outline and cross section of the impregnated zones. This fact is brought out clearly by an examination of the Hatch mine on Indian Creek and also the Asphalt mine near Green River, where operations are now carried on in this material.

An operator going into this district should not expect to find a bed of this material which will be of uniform thickness for any great extent. It is just as liable to grow thicker as to grow thinner, this depending largely on the relative porosity of the beds. The thickness and extent of the deposit can easily be outlined by drilling and keeping a careful record of the holes, thus giving the necessary data for the proper economic development of a deposit.

The possible uses to which the asphalt will lend itself may be outlined as follows:

1. As a paving material for roads or streets, flooring of buildings or inclosures.
2. As a roofing or covering for buildings.
  - (a) Asphalt shingles.
  - (b) Roofing felt or paper.
  - (c) As a covering alone or with sand or gravel.
3. As a preservative.
  - (a) As an injection for wood.
  - (b) Paint for wood or metal.

## THE USE OF ASPHALT AS A PAVING MATERIAL.

Asphalts of various compositions have been used for a long time for paving streets. The main consideration as to the qualifications of these asphalt rocks for this purpose is the percentage of asphalt contained. It may contain too much, which will make the surface of the road too soft in warm weather, while in extremely cold weather it may seem to be of about the proper consistency. On the other hand, if the material contains too little asphalt, it may work well in warm weather and become brittle and disintegrate in cold weather.

This material has been mined for a paving material for some time by the Wadsworth Stone and Paving Company, which is operating a plant at Asphalt on Green River, below Brownsville.

An example of what this material will stand when used over a crushed rock foundation, can be seen in the city of Bowling Green, Ky., where a small amount of the rock was used on one side of the public square. This piece of pavement undergoes severe usage continually and shows no sign of deterioration after having been in use for five years, with the exception of a few chuck holes which are doubtless caused by local imperfections in the foundations. The asphalt in these holes shows no more sign of wear than on the level surface. It would naturally be supposed that the shock of heavy wheels dropping into a chuck hole would soon tend to cause tension cracks along the sides of the depression, but none were

seen. The material seems to have lost none of its original flexibility or elasticity and has not dried out to any appreciable extent.

On the road toward the cemetery, near the edge of the same city, is another place where a short stretch of road was treated with this material over a crushed lime rock foundation. Wagons heavily loaded with logs are hauled over this road, but there are no signs of rutting. There are a few chuck holes caused, as before stated, by imperfections in the foundation, but there seems to be little or no wear or deterioration in the elasticity and toughness of the cementing material.

The rock for these tests was simply quarried, crushed and applied to the road surface and rolled, there being no expensive processes of preparing the material.

A black rock from Breckinridge County, very similar to the black rock of the region under discussion, has been used in paving streets in St. Louis with good results. It has also been used in Buffalo and elsewhere. In many cases the specifications call for it to be mixed with an asphalt rock from some other locality in order to obtain the proper composition for a good road surface. The best proof of the satisfactory qualities of this rock as a paving material is the continued activity of the company now operating at Asphalt, Ky. If the black rock did not answer the requirements for paving, this operation might be expected to dwindle or cease entirely.

In considering the use of this rock in its crude form as a road building or paving material, the question arises what freight rate will preclude the possibility of competing with other products when initial cost is the prime consideration? In the first place initial cost should not be the prime consideration in a matter of this kind, as the durability of the various materials used as road coverings varies to a considerable degree. The ultimate cost, taking into consideration the factors of life of the material, renewability and character of surface as well as the initial cost, should govern the selection of a material for this purpose. If these factors are given their proper weight in considering bids on a contract, this

black rock ought to compete with any other material known, with a fair possibility of success, excepting at such distances from its source as would make the freight excessive. As this rock only contains from five to twelve per cent of asphalt, the freight paid would be mainly upon the sand, which together with some small amount of impurities constitutes the balance of the material, i. e., from 88% to 95%. To make the asphalt content compete with other material when loaded down with freight charges against such a large proportion of sand, which can be very cheaply obtained by most consumers, would seem ridiculous at first, but a study of the expense of purchasing and operating machinery which will produce as thorough a mixture as nature has produced in the form of this black rock, seems to show that aside from a saving of from three to five cents per square yard of pavement in place, the black rock offers additional advantages from being a perfect mechanical mixture of the materials, requiring no preliminary heating of either the asphalt or the sand, a considerable advantage when the disagreeable features attending the use of these heated materials in a residence district are considered, more especially when portable melting and heating plants are used. It is also advantageous because it offers a surface which does not become slippery. The sand grains in the black rock pavement offer much more resistance to skidding wheels than the ordinary asphalt pavement surface will offer. In the writer's opinion the use of any crushed argillaceous or calcareous material on the surface of an asphalt pavement will result in the production of a thin slippery coating when the pavement is wet and heavy traffic is passing over it. Limestone or cement does not stand up under traffic and pure quartz sand will.

The percentage of accidents due to skidding on a wet pavement could be considerably reduced by using a material which offers a slightly abrasive surface such as is offered by this black rock when properly laid.

By properly applied experimentation the most suitable percentage of asphalt content in the rock, for the various uses to which it may be applied, can be easily determined. It is possible that a wide variation in the

asphalt content may be found when extensive operations have been carried on in quarrying this material. At present we know the content varies within comparatively narrow limits, depending upon the porosity of the formation in which it occurs. There are limestones in the Chester group occurring in the district under discussion which will show a low content of asphalt, which may be found useful, if it should be desirable to decrease the total asphalt in the rock by crushing and thoroughly mixing the lime rock with a sand which is too rich in this material.

This asphalt rock may find a wide use as a paving material in large buildings, such as warehouses, stables and stock yard shelters, especially in the two latter, where collection of animal excrement is made for manufacture of chemicals and fertilizers, where a water and chemical proof material will aid greatly in the saving of valuable solutions.

Very little is known at present as to the cost of distilling the asphalt from the black rock. It can be accomplished in various ways and has been done in a small way in several places in the district in the past. The black rock may be crushed and thrown into boiling water and thoroughly agitated, whereupon much of the asphalt rises to the surface and can be strained off, or the black rock may be treated by heat in a retort and much of its asphalt content obtained as it melts and runs off through ducts provided for that purpose. There would be some loss, however, of the more volatile material by the latter method. Both of these methods have been tried and a considerable quantity of the asphalt obtained by them. It is not definitely known what percentage of recovery can be effected by either of these processes, but it is fairly certain that the distillation will not yield all of the asphalt, though the recovery may be high. Whatever method is used in distillation, a product will result which will have a variety of uses. The asphalt thus produced may be able to compete with other asphalts used in paving where the distance is too great to warrant the shipment of black rock in its natural state. This would depend upon the cost of distillation primarily, of which nothing is known at present. This distillate may be used

to a considerable extent in the briquetting of fuels, whether coal, coke or wood waste. By proper experimentation the characteristics of this material when used for this purpose can be determined and by the addition or removal of certain ingredients it may be found that a binder answering all requirements for briquetting purposes may be obtained. The two things to be watched most closely in this experimentation are the hardness of the binding material and the tendency of the briquettes made with it to disintegrate when fired.

By distillation a product may be obtained which can be used advantageously in the manufacture of roofing material, either as a coating to be used with sand, gravel or crushed rock of any kind, or as an ingredient in the manufacture of a roofing felt or paper, or further as a prime constituent in the manufacture of asphalt shingles or tiling. By experimentation the quality of the distillate may be made to conform to the requirements of the manufacturers in each case.

As a preservative—

(a) As an injection. No data is at present available regarding the efficiency of asphalt when used as a preservative of timbers, but the experimentation thus far carried on in this line seems to show that petroleum oils when used in this way have little to recommend them for such use, in part because they do not penetrate the timber to a sufficient extent to wholly protect it against the ravages of fungus growth or rot of any kind and partly also because of the initial expense of the treating process, which does not, according to our present knowledge, increase the life of the timber to a degree which warrants this expenditure. It is probable that the use of asphalt in this line will be limited until further investigation of the subject is made.

It is quite possible though that extensive impregnation of the timber treated is not necessary for its preservation when a water and acid proof material is used as a heavy impervious coating and where some impregnation, even though comparatively slight, is secured. Where the treated timber thus far has not been water and acid proof a complete or comparatively complete impregnation by the preservative has been necessary.

Where timbers are not subject to wearing or cutting agencies a coating of asphalt which would penetrate to some extent at least might be found to be as efficacious as an injection of other preservative material.

(b) As an outside coating to protect both wood and metal from deterioration the asphalt will find a wide use.

Some of the settlers in the district under discussion have used the "tar" to coat the butt ends of gate posts and fence posts to prevent rot. The timber thus treated, however, was either white cedar or mulberry, both of which are long lived timbers, and the results obtained show no very great increase in the life of the treated material over its life when not treated. The writer examined a few of these posts and found no sign of decay in the butts which had been treated; there was some natural deterioration in the untreated portion of the timber which are nearest the ground, and judging from appearances it was evident that the treatment did protect the posts from rot. If a shorter lived timber had been used in these cases a more marked difference in the treated and untreated posts would undoubtedly have been shown.

When the requirements as to quality and composition of the material required are determined a product answering these requirements can undoubtedly be produced from the asphalt and it ought to find wide use in the coating of ties, posts, poles, piling, bridge and river timbers, and also for flooring of bridges and coating of blocks for block pavement. In many cases the life of a tie depends more largely upon the character of the roadbed than upon the lasting qualities of the timber. A roadbed which "heaves" in winter necessitates the use of shims and shimming spikes which cut the tie, then when warm weather comes the shims are removed and the rail is respiked, so that after a very few seasons the tie is so cut by frequent spiking that it is practically useless. If, therefore, a very cheap tie can be used coated so that it will last until it must be removed on account of spike cutting the maximum economy in maintenance will be secured. It may be possible that bridge flooring and block pavement can be treated with this material

cheaply enough to compete with creosoted material when the cost of recoating at intervals when necessary is included and when the conditions are propitious.

This material should be useful to manufacturers of paints or coatings for wood or metal pipes, containers and conveyors used where acid fumes exist or solutions are to be handled which would corrode the untreated material. There are various manufacturers today who produce paints and varnishes with asphaltic bases who might make use of large quantities of this material.

Another use to which it may be put is in waterproofing foundations and walls by incorporating a layer of the material in the walls during the process of construction.

In considering the distillation of this material from the rock the disposal of the by products will be an important item. Much of this black rock when freed from the asphalt is an almost pure white sand containing little or no cementing material and might find ready use in the manufacture of glass.

### CLAYS.

The clays of this region may be separated into two classes—residual clays, left from the recent breaking down of formations by the various atmospheric agencies, and original sediments, such as the fire clays, either plastic or indurated.

RESIDUAL CLAYS.—There are numerous small areas in this district containing these clays, some of which are of good quality and can be used in the manufacture of brick, tile and conduit. One of the best examples of these is on the farm belonging to John Gibson where a brick yard was operated some years ago.

Samples from this yard, which is situated about three-quarters of a mile north and west of Bee Springs, show that a product of fair quality for building purposes can be obtained from this deposit. The depth of the deposit is not known, but that it will exceed five feet is certain. Its area is indeterminate, but it is known that an area of at least one hundred acres is covered with this material. It occurs at the surface, being covered by only a very thin layer of soil.

A very tenacious clay is found in the ridges at the heads of Beaver Dam, Sycamore, Pine and Indian Creeks. This bed lies below a series of thin-bedded sandstones which varies in thickness from four to fifteen feet. In some places the sandstone has been cut through by erosion and the clay exposed, being marked by a more gentle slope than is found over the more resistant rocks. This clay contains some small fragments of a highly ferruginous sandstone which would have to be removed before it could be utilized. The clay itself is from five to eleven feet thick. Below it is a thin bed of low-grade iron ore underlain by a thin carbonaceous shale containing a few thin seams of bright coal, not more than a quarter of an inch in thickness. The overburden could be removed from this clay bed quite cheaply if worked on a large scale. The clay is so tough that the separation of the sandstone fragments imbedded in it would prove a difficult problem unless it be mixed with sufficient water to make a very thin mud, and this mixing process might disintegrate the sandstone impurities to the detriment of the resulting refined product. The area over which this clay extends is comparatively large, but quite irregular and its acreage can only be roughly estimated at something like eight hundred acres.

In a former report on this district made many years ago, a series of variegated clays was reported found on J. Sowder's farm on the Caney Branch of Gulf Creek. The writer visited this farm, but the clay bank was so covered with the products of erosion that no thickness could be determined nor a good section of the various differently colored strata obtained. The bed is said to be seven or eight feet thick.

An analysis of these clays is given in Kentucky Geological Survey, Volume IV, New Series, page 63, and is given herewith:

#### EDMONSON COUNTY CLAYS.

No. 1767. "Siliceous clay, from Sowder's farm, near Green River. Chester Group. Bed four to six feet thick. Collected by John R. Procter."

No. 1768. "Clay from Sowder's farm, on Caney Branch, one mile from Green river. Bed seven to eight feet thick; in layers of various colors. Collected by John R. Procter."

(a) The upper or light-dove-colored layer.

(b) The second, light grey, nearly white layer.

(c) The third, grey layer.

(d) The lowest layer. Olive-grey, mottled with yellowish-grey.

Composition of These Edmonson County Clays Dried at 212° F.

	No. 1767	No. 1768-a.	No. 1768-b.	No. 1768-c.	No. 1768-d.
Silica .....	80.160	77.680	74.460	71.560	67.560
Alumina and iron and mangoxide .....	11.600	16.800	20.440	22.860	22.540
Lime carbonate .....	.760	.480	.640	.680	.960
Magnesia .....	.560	not est.	not est.	not est.	.671
Phosphoric acid .....	not est.	not est.	not est.	not est.	.025
Potash .....	3.354	1.002	not est.	not est.	2.470
Soda .....	.583	.484	not est.	not est.	.058
Water and undetermined	2.483	4.340	4.460	4.900	5.696
Total .....	100.000	100.766	100.000	100.000	100.000

While these clays would not prove very refractory in the fire, they may be made very useful for common pottery ware.

The area underlain by these clays is indeterminate. It is known, however, that the deposits extend for at least a quarter of a mile south from the exposure seen.

There are numerous thin beds of a white siliceous clay in various horizons which are used locally for white-washing buildings and fences and applying to floors as a cleaner, but the deposits are so deeply buried by overlying strata as to render their extraction in any large quantity too expensive to permit their use on a commercial scale.

**FIRE CLAYS.**—There is a small deposit of flinty fire clay outcropping in the Leitchfield and Brownsville road on the head of Indian Creek. The thickness is approximately two feet over an area of at least one hundred acres. The overburden is loose and would have to be removed in order to get at this material. The thickness of this overburden, which consists of residual sands and clays, is from two to fifteen feet.

The fire clay found below the coal in many places is

very thin, ranging from a fraction of an inch up to eight inches. It is unusually plastic and considerably stained with iron, as most of the shales in the coal horizon carry more or less iron sulphide which near the surface soon oxydizes and stains the strata in the immediate vicinity. It is possible that on getting farther into the hills when mining the coal that a white clay can be taken up from the floor, as it will have to be in securing proper drainage for the workings, and being produced cheaply may be of some commercial value.

A clay running very high in alumina is found in several places in the district, occurring at or near the base of the conglomerate. In appearance it is a mineral of resinous lustre and is locally termed "resin."

On the Jack Elmore farm, on Indian Creek, the writer sunk a test pit in this material and found beds, slumped from the outcrop which must have been not far from the pit, which corresponded to a thickness of at least fifty-six inches. The material varies in color from an almost pure white, through yellow to a dark green. It is of low specific gravity and its hardness is about two by Mohs' scale of hardness. An analysis of this material from a sample taken out of this test pit shows the following composition:

	Per cent.
Moisture .....	13.65
Ignition (combined water and volatile matter).....	20.92
Silica .....	20.04
Alumina .....	40.53
Ferrie oxide .....	1.24
Lime .....	0.36
Magnesia .....	0.40
Potash .....	0.31
Soda .....	None
Phosphorus pentoxide .....	3.75
Titanium dioxide .....	A trace
Sulphur trioxide .....	0.27
Total .....	101.47

This clay corresponds closely to the mineral Allophane.

This same material is also found on Smith Brook's farm, one-fourth mile southeast of Cove Hollow School House, on the north prong of Bylew Creek. The material is found in place here just above the fossil rock and below the sandy conglomerate. The succession here is as follows, beginning at the bottom: limestone, fossiliferous, then dark brown sandy clay containing some thin seams of the resin-like mineral (the thickness of this brown clay is not exactly known as the test pit here did not penetrate to the limestone which shows in the branch a short distance below here), then a vein of this mineral 14 to 16 inches thick, then compact clay free from sand 2 inches, then sandstone conglomerate. This seam extends entirely through the hill, which is an eighth of a mile wide at this point, some of the mineral shown in the wash of the branch on the side opposite the place where the test pit was sunk. No use has yet been found for this mineral on account of the high percentage of silica contained, but its high content of alumina is worthy of note. In general the clays of this region, while they occur in considerable quantities, are not of very great economic importance as compared with the other minerals of the district.

#### MARLS.

The so-called Leitchfield marls are found in large quantities and of many colors over the northern portion of this district. They have been fully described in some of the previous reports of the Geological Survey and analyses given showing their composition and will only be briefly referred to here as possible fertilizing material if means be found to render available the large percentage (mostly insoluble) of potash which some of them carry. They would for this use be more adapted to thin sandy soils, furnishing not only lime and potash, but acting mechanically to add a clay material to those soils deficient in the latter. It is quite possible that some of the brighter colored of these marls might be used in the manufacture of a cheap pigment, being very fine grained and carrying no grit. Tests on a small scale gave colors which were permanent and stood weathering very well.

## SANDS AND GRAVELS.

Most of the sands of this district are so heavily impregnated with ferruginous material that they will be of little value for industrial purposes. There are, however, several strata of the Bee Springs formation which produce a white sand having a comparatively wide range in coarseness of grain. The relative thickness of these strata will make the cost of production rather high unless they are mined on a large scale.

One white sand is found in this formation about one mile west of Evan Merideth's, on the road to Bee Springs. It is capped and underlain by cross-bedded strata rich in ferruginous cementing materials. The extent to which this cementation has penetrated the white sand seems slight at the outcrop. This is a fine grained sand. It finds local use as a polishing and cleaning material.

On Smith Brook's farm, on the north prong of By-llew Creek, there is a deposit of white sand, washed down from the hills, which is at least 30 inches thick. It is covered by from three to four feet of sandy soil. This material shows very little impurity and is of fairly coarse grain and may prove to be of value either in the glass industry or in foundry work by sizing properly.

The weathering of the thick conglomerate at the base of the coal measures yields a material which might well be used for roadbed either on highways or railroad, the percentage of pebbles remaining after some of the sand has been washed away being high, forming an excellent material for ballast. This material is characteristically developed at the foot of many of the hills which are chiefly composed of this conglomerate.

The old Nolin iron furnace is lined with a sand which occurs about twenty-five feet below the fossil rock. This sand seems to have stood up well under the heat, as it is still intact and does not crumble easily.

A similar sand can be procured from the Bee Springs formation near its top, but it is not known how it will act in a furnace. Large quantities of this fire sand from the Chester Group can be procured above Snap, on the Hunting Fork of Rock Creek, where it outcrops on

the south and east side of the creek with a thickness of about 10 feet exposed.

A thin bedded sandstone occurs near the top of some of the hills near Segal, which may be the southern extension of the Bee Springs formation. This material is about fifteen feet thick and can be taken out in layers from a fraction of an inch to two inches in thickness. It is used locally for whetstones and seems well adapted to this use, being free from nodular or concretionary formations and having a uniformly even and fine grain. It is not discolored to any great extent by iron or other impurities, but is of very light yellowish tinge. It would be possible to secure large quantities of this material in sizes which would permit the manufacture of abrasive material from the size of small pocket whetstones to that of large grindstones. It is not heavily covered and can be cheaply quarried. The acreage covered is relatively small, the material occurring only on the tops of the hills, but the quantity available is ample to support a considerable industry.

Much of the sand rock containing the asphalt is composed of a pure white sand, the asphalt having prevented impregnation by ferruginous and calcareous cementing material. If distillation processes are used in the production of the bitumen the sand by-product may be found useful in various industries.

## IRON ORE.

There are numerous bands of iron ore in this region which have been described in a former report on this district. The majority of them are comparatively thin and covered by a heavy overburden necessitating underground methods of production.

There is a thin nodular ore occurring between the conglomerate and the upper measures of the Chester Group. According to analyses made by the Geological Survey this ore is highly siliceous, contains considerable phosphorus and sulphur and a comparatively low percentage of metallic iron. Its poor quality and the expense attendant to its production renders its development on a commercial scale improbable.

Another ore is found at or near the top of the con-

glomerate which seems to extend practically throughout the entire region. Its thickness and richness varies considerably, but at no place is it found of sufficient richness and thickness combined to warrant extensive development. In some cases it is found lying directly above the coal, where the coal rests immediately above the conglomerate. In those places where there are intermediate formations between the coal and conglomerate, this ore is found below the coal. It is produced largely by the oxydation of the iron salts in solution which find outlet in this horizon. The outcrop is, as a rule, much richer where the flow of water is comparatively strong, but the richness decreases as we leave the water and as we go into the hill. Where little or no water action is found in gullies cutting back into the hills we find this ore is lean and highly siliceous.

Above this ore and below the Bee Springs sandstone we find in numerous places throughout the district, where these formations are plainly recognizable, an iron ore which is mainly limonite, but which contains much silica. Like the previously described ores it is thin and variable in its iron content, and will be of little value commercially.

Above the Bee Springs sandstone in the ridge at the heads of Decker's Branch and Davis Branch we find an ore which was mined and smelted at the old Nolin furnace which is located near the mouth of Davis Branch. There were at least three openings made on this ore. One called McGrew's ore bank which is near the Brownsville and Leitchfield road, about four and one-half miles above Bee Springs; another some two miles farther north and a third on Davis Branch not more than a mile from the old furnace.

All of these deposits have relatively small areas. They occur near the tops of the hills and cover from fifty to eighty acres. The ore is thin and shattered. In order to produce an ore of good quality hand sorting would have to be resorted to. The thickness varies from two to eight feet, but not over fifty per cent of the material would be included in the sorted product. Some ore could be secured here by small operation in case an iron industry was started in the region.

South of Bee Springs are the best iron ores above the Bee Springs formation. The productive area here is approximately 1,500 acres as far as could be outlined from surface showings.

One ore bank called the Frederick bank shows a red hematite mixed with limonite, but quite sandy. A test pit was sunk back of this outcrop and the bed of ore cut showed much less iron. The outcrop was between six and seven feet thick. The ore bed in the pit was about thirty-six inches thick, showing that by leaching and subsequent deposition the outcrop had become enriched and thickened at the expense of the rest of the deposit.

On the headwaters of Sycamore Creek, about three-fourths mile west of the Leitchfield and Brownsville road, is located the Procter ore bank, where a limonite is found which is oolitic in appearance. This is by far the best ore in the district. A test pit was sunk here which showed 38 inches of ore with the possibility of a slightly greater thickness on entering the hill, as some float was found immediately above the ore. This ore occurs in massive layers from ten to eighteen inches thick. The area covered by it is not accurately known, but it will be found in most of the hills in the immediate vicinity and there should be at least a thousand acres of productive area. The capping is a thin bedded sandstone and some interbedded and residual clays. The maximum thickness of the overburden is approximately 30 feet, but much of the ore could be uncovered by stripping less than ten feet of surface material.

Following are analyses of these ores:

	No. 1	No. 2	No. 3
Metallic Iron .....	28.70.....	20.66.....	36.64.....
Phosphorus .....	0.57.....	0.165.....	0.40.....
Silica .....	42.00.....	48.80.....	26.40.....

No. 1 is an average sample from the outcrop of the Frederick bank.  
 No. 2 is an average sample from a test pit back of the outcrop.  
 No. 3 is an average sample from the Procter bank.

## LIMESTONES.

The limestones of the northern part of the district are by far the most important from an economic point

of view for the reason that they outcrop in such a way as to be easily quarried.

Some of the lower strata of the Chester which outcrop in the extreme northern part of the district are fairly coarsely crystalline limestones which can be used for the production of lime and cement, the latter when properly mixed with argillaceous material. The iron content of these rocks is small and their lime content is rather high. Some of the thinner strata are fine grained and could be used for building material.

At the southern end of the district there are a few places where limestone could be cheaply obtained, but in much smaller quantities than in the northern end.

The relative importance of these rocks is slight as compared to other economic features of the region. There are numerous fields outside the district where limestone is now produced and unless a rock of much better quality for its special purpose could be produced in this region, it is doubtful if a profitable industry in this line of operation could be developed without a severe struggle against the competition of the concerns now operating. There do not seem to be any limestones in this district occurring in sufficient quantities and possessing such special characteristics as would warrant their extensive development in the face of a strongly competing market.

### OIL AND GAS.

The structure of the district does not indicate that the occurrence of oil or gas is very probable. There are several small folds in the region which have been discussed in connection with the general structural features, but they are all of such size as to preclude the possibility of their extending to any great depth and forming such structure as is characteristic of the most productive fields. This lack of anticlinal structure is considerably against the probability of the existence of extensive oil or gas fields.

Several wells have been put down in this region. All of them show some signs of the presence of oil at various horizons and some oil seeps from the rock into these wells, but nothing has been found as yet to war-

rant the assumption that productive fields will be found. A possible exception to this is in the vicinity of Leitchfield, at the extreme northern edge of the district. The Rough Creek uplift crosses here, forming a complete arch in the rocks in the town. A well drilled a number of years ago directly on the summit of this fold gave no results, but it is not impossible that other wells farther down the slope might give production.

The following is the record of an old well drilled on a branch of Dismal Creek:

	Thickness	Depth
Clay .....	8	8
Black sand .....	25	33
Shale .....	25	58
Limestone .....	9	67
Shale .....	15	82
Limestone .....	34	116
Shale .....	8	124
Limestone .....	42	166
Shale .....	17	183
Limestone .....	20	203
Black sand .....	15	218
Sand and Shale.....	42	260
Shale .....	20	280
Gray Limestone .....	524	804

This well started just below the lowest coal.

### MINERAL WATERS.

There are numerous mineral springs in this district, the most noted of which are those at Grayson Springs. These are sulphur springs, and the waters have been treated of in detail in former reports of the State Geological Survey.

A well drilled for oil at Snap showed sulphur water until a well at Iberia was drilled, when the water in the Snap sank rapidly and sulphur water showed up in the Iberia well. This well was plugged below the flow of sulphur water to keep out what small amount of oil might seep in. A sulphur spring also is found on Conoloway Creek, on Shelton Van Meter's land.

There are a great many chalybeate springs from which issue waters containing salts of iron, which are

rapidly oxydized on approaching or reaching the surface, forming a reddish slime.

A hotel was formerly located at the locally famous Gulf Spring, the waters of which are chalybeate with an intermittent flow. This spring is located near the forks of Gulf Creek.

Springs carrying considerable iron in solution issue from the base of the conglomerate in very many places and also from the base of the Bee Springs sandstone in some instances. Some of these springs might prove to be of some value if transportation facilities were better in the district.

### TRANSPORTATION.

At present the only means of transportation are by wagon haul to the Illinois Central Railroad at the extreme northern edge of the district or by boat down Nolin and Green Rivers. Both are costly and unsatisfactory. A railroad could easily be built from some point on the Illinois Central Railroad to Bowling Green, giving an outlet in both directions. Until this is done development of the mineral resources of this section will be very slow.

### SUMMARY.

The areas outlined on the accompanying map indicating the region underlain by coal and asphalt rock are approximate only. The outline of the coal area is fairly accurate, and it is certain that all the land included is underlain by the Nolin coal. The outline of the asphalt area must necessarily be approximate in that the impregnation of the rocks is uneven and by no means continuous.

Some impregnation may extend beyond the outlined area and much of this area shows no impregnation at the surface. But it is known that the rocks within this area are liable to be impregnated to a great extent where no evidence of it is seen at the surface. There is no reason to suppose that the outcrops show the full range of impregnation.

### COAL.

The coal which will pay to work in this area underlies approximately 75 square miles. The average thickness is about 34 inches. The thickest part of the coal forms a belt just below the middle of the district from Cane Camp Branch to Pine Creek, on the east, and from Shoal Branch to Beaver Dam Creek on the west.\* On the east side of Nolin River this belt includes the region from Higdon's Branch, above Longfall Creek, to midway between Brier Creek and Bylew.

The average thickness of the coal in this belt is at least 38 inches. Here also are found the best mining conditions. The roof and floor are solid and the dip is just sufficient to guarantee natural drainage and easy haulage if the seam is entered from the lower side.

The coal in this belt carries much less sulphur than that farther south and breaks well into fair sized blocks. The water is somewhat stronger here than elsewhere, but with natural drainage this will not raise the cost of production to any great extent.

In P. N. Moore's report on this district ten analyses of this coal are given which show the Nolin coal as a coal of good quality. Its ash content is a trifle higher than that of the old Bell coal and its fixed carbon content a little lower. The sulphur is higher than that of the Bell coal, but not high enough to prevent the production of a fair grade of coke. All things considered there is a large tonnage of coal of good quality available at low cost as compared to districts where shafts must be sunk and water pumped.

### ASPHALT.

The area outlined on the map as containing asphalt is about 80 square miles. By no means will all this area show outcrops impregnated with this material, but the outline defines roughly the limits to which the impregnation has extended and includes some acreage in which no asphalt is seen, but which may be proven to contain it by prospecting.

\*See accompanying map.

Taking into consideration the outcrops only, there is a vast tonnage of this impregnated rock which may be easily obtained. In many places quarries can be opened up with a face of black rock at least twenty feet thick vertically. In some instances the face may be two, or even three, times this thickness. Careful prospecting by drilling will show up whatever irregularities may exist in the thickness of the deposits and furnish a basis upon which to plan the development of the properties.

The uses to which this asphalt rock can be put are many. In its crude form it can be used as a road material with good results and ought to be able to compete with other bituminous rock within a comparatively large radius from the source of the material. The surface produced when it is used is gritty enough to prevent much skidding. In respect to durability it is far ahead of rocks having a limey constituent. The quartz sand does not crumble under heavy traffic as does the limestone, and no thin coating of mud is produced when the pavement is wet as is the case when a bituminous limestone is used or when a crushed limestone is mixed with asphalt.

Little or nothing is known at present as to the probable cost of distilling the asphalt from the rock containing it. If this can be done at a reasonable cost the resulting distillate will be found to have many industrial uses.

It might compete with other fluid or semi-fluid asphalts in paving either roads, streets, warehouses or stock yards where a water proof flooring might be desired. Its use as a base for paints and varnishes when properly refined might be extensive. It may also be found that this material or some of its constituents may be used to advantage in the preservation of timbers of various kinds, either as an injection or as a coating.

#### CLAYS.

There are various clays in the district which are available for the manufacture of brick and others which could be used for drain tile and vitrified pipe. Certain of these latter clays could be used in pottery. The ex-

tent of these deposits is indeterminate, but it is known that there is an ample supply to furnish material for a considerable clay industry for a long term of years.

#### MARLS.

It has been suggested that the Leitchfield marls might well be utilized as fertilizer for sandy soils. Their effect upon the physical characteristics of clay soils might reduce rather than increase its productivity.

As pigments they may find considerable use, as they are fine grained and their colors are permanent. The supply for all purposes seems almost inexhaustible and it can be secured at very low cost.

#### SAND AND GRAVELS.

There is very little sand in the district which may be classed as a glass sand unless it be the sand by-product, which would be rejected after the distillation as asphalt from certain horizons in the conglomerate or Bee Springs sandstones. There is a small deposit on Bylew Creek which could furnish a total of from 30,000 to 40,000 short tons. This sand and some others in the region could be used in foundry work. Much of the sand left from distillation of asphalt from black rock could also be used in the manufacture of sand-lime brick.

The gravels of the district can well be used as road material. The supply is ample and it can be obtained without excessive expense.

#### IRON ORES.

The iron ores of the district are limonites of fair grade and could be mined at a reasonable cost. The quantity available might support a small iron industry, which might pay fairly well having its fuel, ore and fluxes close at hand.

#### LIMESTONES.

Limestones are numerous in this district, but it is only in the northern and southern parts where opportunity exists to quarry them. There are some good

building stones and others may be found well adapted for use in the manufacture of cement with the addition of argillaceous material, plenty of which is available.

None of the stones offer any special advantages over stones of other localities where extensive operations are now being carried on, hence the development of the limestones of this district may be slow and of limited extent.

#### OIL AND GAS.

There are no structural features which indicate the existence of extensive oil or gas deposits which would prove of commercial value, with the possible exception previously noted.

#### MINERAL WATERS.

Both sulphur and chalybeate springs are numerous in the district, the latter being by far the most abundant. It is possible that some of the largest of these might be developed and exploited.

#### TRANSPORTATION.

The transportation facilities of the district at present are very poor in that boat rates are high and the flotilla is of limited size. The wagon roads are in very poor condition, having been neglected after being cut up by tie hauling. A railroad could be built at a reasonable cost from the Illinois Central line following the main water shed between Bear Creek and Nolin River to some point on Green River. There are no topographic features offering any great obstacles to an essentially surface road.

### COAL ANALYSES IN THE WESTERN COAL FIELD

## TABLE OF CONTENTS.

	Pages
Butler County .....	225 to 227
Gillam Mine .....	225 to 227
Christian County .....	228 to 232
Empire Mine .....	228 to 232
Davless County .....	233 to 239
Rudy Mine .....	233 to 236
Fulkerson Mine .....	237 to 239
Henderson County .....	240 to 260
Pittsburg Coal Co., No. 1 .....	240 to 244
Nicholson Mine .....	245 to 247
Panama Mine .....	248 to 250
Corydon Mine .....	251 to 255
Smith Mills Mine .....	256 to 260
Hopkins County .....	261 to 314
Reinecke Mine .....	261 to 270
Arnold Mine .....	271 to 279
Nebo Consolidated C. Co. Mine .....	280 to 286
Nortonville No. 1 Mine .....	287 to 293
Fox Run Mine .....	294 to 302
Carbondale No. 1 Mine .....	303 to 309
Workman Mine .....	310 to 314
McLean County .....	315 to 319
O'Neill Mine .....	315 to 319
Muhlenberg County .....	320 to 335
Central Mine .....	320 to 323
Bevier Mine .....	324 to 326
Skibo Mine .....	327 to 328
Lam Mine .....	329 to 335
Ohio County .....	336 to 346
Broadway Mine .....	336 to 337
McHenry Mine .....	338 to 339
Crown Mine .....	340 to 346
Union County .....	347 to 381
Bell Mine .....	347 to 348
River, Rail Coal and Coks Co. Mine .....	349 to 354
Morganfield Mine .....	355 to 359
West Kentucky No. 8 Mine .....	360 to 365
West Kentucky No. 9 Mine .....	366 to 370
DeKoven Mine .....	371 to 377
Crittenden Mine .....	378 to 381
Webster County .....	382 to 414
Sebree Mine .....	382 to 384
West Kentucky No. 4 Mine .....	385 to 390
Providence Mine No. 3 .....	391 to 397
West Kentucky Mine No. 7 .....	398 to 404
Shamrock Mine .....	405 to 414

The following analyses and mine sections (with the exception of numbers 96, 97, 98, 99, 100, 101, 102, 103, 104, 112, 113, 114, 115, 123 and 124, which were made previously by the U. S. Bureau of Mines, and are here copied from their publications) were made during the spring of 1914 by the Kentucky Geological Survey and the U. S. Bureau of Mines acting in co-operation. Sections of the faces of the veins are given along with analyses from samples taken at different points in the mines and, for most of the mines, a composite analysis from the different samples.

The analyses were all made at the laboratory of the Bureau of Mines.

Some few mines could not be represented owing to the fact that they were closed and not being operated when this work was done.

J. B. HOEING.

## BUTLER COUNTY.

## No. 1.

Laboratory number .....19,399  
 Operator .....Gillam Coal Company  
 Mine (drift) .....Gillam  
 Location ..... 1½ miles S. W. of Morgantown  
 Location in mine.....Left rib of room 1, off main west entry,  
 100 feet from entrance.  
 Coal ..... Unclassified  
 Date of sampling .....5-1-'14  
 Date of analysis .....6-2-'14  
 Depth below surface.....25 feet

## SECTION OF MINE.

Roof—Hard, Blue Shale		Feet	Inches		
1. Bone coal .....			2¼		
2. Coal .....			6¾		
3. Soft sulphur band.....			¾		
4. Coal streaked with sulphur.....		2	6		
5. Bony coal high in ash.....			5		
Total .....		3	8¼		
Floor—soft fire clay.					
Excluded from sample, No. 1.					
Air-dry Loss, 3.6.		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.55	8.93	.....	.....
	Volatile matter ..	40.75	39.29	43.14	47.38
	Fixed carbon .....	45.25	43.63	47.91	52.62
	Ash .....	8.45	8.15	8.95	.... ..
		100.00	100.00	100.00	100.00
Sulphur		3.24	3.12	3.43	3.77
Calorific Value Determined	Calories ..	6934	6686	7342	8064
	B. T. U. ..	12481	12035	13216	14515

## BUTLER COUNTY.

No. 2.

Laboratory number ..... 19,400  
 Operator ..... Gillam Coal Company  
 Mine (drift) ..... Gillam  
 Location ..... 1½ miles S. W. of Morgantown  
 Location in mine ..... Rib of room 1, off main west entry,  
 100 feet from entrance.  
 Coal ..... Unclassified  
 Date of sampling ..... 5-1-'14  
 Date of analysis ..... 6-2-'14  
 Depth below surface ..... 25 feet

## SECTION OF MINE.

Roof—Bluish-Gray Shale.		Feet	Inches
1.	Bony coal .....		2
2.	Coal .....		7
3.	Mother coal .....		¼
4.	Coal .....	2	7
5.	Bony coal high in ash.....		5
Total .....		3	9¼
Floor—soft fire clay.			
Excluded from sample, Nos. 1-5.			

Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.40	8.45		
	Volatile matter ..	41.35	40.02	43.71	47.36
	Fixed carbon .....	45.97	44.48	48.59	52.64
	Ash .....	7.28	7.05	7.70	
		100.00	100.00	100.00	100.00
Sulphur		3.77	3.65	3.99	4.32
Calorific Value Determined	Calories .....	7056	6829	7459	8081
	B. T. U.....	12701	12292	13426	14546

## BUTLER COUNTY.

No. 3.

Laboratory number ..... 19,401F  
 (Composite of 19,399-400.)  
 Operator ..... Gillam Coal Company  
 Mine (drift) ..... Gillam  
 Location ..... 1½ miles S. W. of Morgantown  
 Coal ..... Unclassified  
 Date of analysis ..... 6-2-'14

## SECTION OF MINE.

Air-dry Loss, 3.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.55	8.76		
	Volatile matter ..	40.95	39.56	43.36	47.28
	Fixed carbon .....	45.67	44.12	48.35	52.72
	Ash .....	7.83	7.56	8.29	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.54	5.73	5.22	5.69
	Carbon .....	69.44	67.08	73.52	80.17
	Nitrogen .....	1.67	1.61	1.76	1.92
	Oxygen .....	11.92	14.54	7.40	8.07
	Sulphur .....	3.60	3.48	3.81	4.15
	Ash .....	7.83	7.56	8.29	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6939	6751	7399	8068
	B. T. U.....	12580	12152	13318	14522
Calorific Value Calculated From Ultimate Analysis					
	Calories ..		6846		
	B. T. U. .		12323		

## CHRISTIAN COUNTY.

## No. 4.

Laboratory number .....19,293  
Operator .....Empire Coal Mining Company  
Mine (shaft) .....Empire  
Location ..... $\frac{3}{4}$  mile west of Empire  
Location in mine.....Face of main south entry,  
3,000 feet from shaft.  
Coal .....Empire  
Date of sampling .....4-24-14  
Date of analysis .....5-25-14  
Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Hard, Gray Slate			Feet	Inches	
Coal streaked with mother coal....			2	10	
Total ..			2	10	
Floor—hard, smooth fire clay. Excluded from sample, none.					
Air-dry Loss, 6.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.95	11.18		
	Volatile matter ..	36.90	34.48	38.82	39.55
	Fixed carbon .....	56.40	52.70	59.33	60.45
	Ash .....	1.75	1.64	1.85	
		100.00	100.00	100.00	100.00
Sulphur		0.90	0.84	0.95	0.97
Calorific Value Determined	Calories .....	7551	7056	7944	8093
	B. T. U. ....	13592	12701	14299	14567

## CHRISTIAN COUNTY.

## No. 5.

Laboratory number	19,294
Operator	Empire Coal Mining Co.
Mine (shaft)	Empire
Location	$\frac{3}{4}$ mile west of Empire
Location in mine	Face of 8th west off south entry, 3,000 feet from shaft.
Coal	Empire
Date of sampling	4-24-'14
Date of analysis	5-20-'14
Depth below surface	100 feet

## SECTION OF MINE.

Roof—Hard Gray Slate		Feet	Inches
1. Coal .....		1	7½
2. Mother coal .....			¼
3. Coal .....		1	5½
4. Mother coal .....			3
5. Coal .....			3
Total .....		3	7¼
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 5.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.39	10.79	.....	.....
	Volatile matter ..	37.61	35.46	39.75	41.17
	Fixed carbon .....	53.73	50.67	56.80	58.83
	Ash .....	3.27	3.08	3.45	.....
		100.00	100.00	100.00	100.00
Sulphur		1.57	1.48	1.66	1.72
Calorific Value Determined	Calories .....	7385	6963	7086	8085
	B. T. U. ....	13293	12533	14051	14553

## CHRISTIAN COUNTY.

No. 6.

Laboratory number .....19,295  
 Operator .....Empire Coal Mining Co.  
 Mine (shaft) .....Empire  
 Location ..... $\frac{3}{4}$  mile west of Empire  
 Location in mine.....Face of 1st north, off 6th west,  
 3,500 feet from shaft.  
 Coal ..... Empire  
 Date of sampling .....4-24-'14  
 Date of analysis .....5-20-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Gray Slate		Feet	Inches
1. Coal			3½
2. Thin sulphur			
3. Coal			6½
4. Sulphur			¼
5. Coal			1½
6. Thin sulphur			
7. Coal			6½
8. Thin sulphur			
9. Coal		1	3½
10. Cannel Coal			3½
11. Coal			2½
Total		3	3¾
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.33	9.59		
	Volatile matter	39.17	37.02	40.95	43.97
	Fixed carbon	49.94	47.19	52.19	56.03
	Ash	6.56	6.20	6.86	
		100.00	100.00	100.00	100.00
Sulphur		2.75	2.60	2.88	3.09
Calorific Value Determined	Calories	7239	6841	7567	8125
	B. T. U.	13030	12314	13621	14625

## CHRISTIAN COUNTY.

No. 7.

Laboratory number .....19,296  
 Operator .....Empire Coal Mine Co.  
 Mine (shaft) .....Empire  
 Location ..... $\frac{3}{4}$  mile west of Empire  
 Location in shaft.....Face of main 6th west entry,  
 4,060 feet from shaft.  
 Coal ..... Empire  
 Date of sampling .....4-24-'14  
 Date of analysis .....5-20-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Gray Slate		Feet	Inches
1. Coal ..			5½
2. Thin sulphur ..			
3. Coal ..			7½
4. Thin sulphur ..			
5. Coal ..		1	9
6. Cannel coal ..			7
7. Coal ..			½
Total ..		3	5½
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 6.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.70	11.24		
	Volatile matter ..	38.40	35.77	40.30	42.42
	Fixed carbon ..	52.13	48.55	54.70	57.58
	Ash ...	4.77	4.44	5.00	
		100.00	100.00	100.00	100.00
Sulphur		2.28	2.12	2.39	2.52
Calorific Value Determined	Calories .....	7289	6789	7648	8060
	B. T. U. ....	13120	12220	13766	14490

## CHRISTIAN COUNTY.

No. 8.

Laboratory number .....19,297F  
 (Composite of 19,293-94-95-96.)  
 Operator .....Empire Coal Mining Co.  
 Mine (shaft) .....Empire  
 Coal .....Empire  
 Date of analysis .....5-20-'14

Air-dry Loss, 6.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.93	10.79	.....	.....
	Volatile matter ..	38.07	35.72	40.04	41.83
	Fixed carbon .....	52.94	49.68	55.69	58.17
	Ash .....	4.06	3.81	4.27	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.51	5.85	5.21	5.44
	Carbon .....	74.62	70.02	78.49	81.99
	Nitrogen .....	1.76	1.65	1.85	1.93
	Oxygen .....	12.19	16.92	8.22	8.59
	Sulphur .....	1.86	1.75	1.96	2.05
	Ash .....	4.06	3.81	4.27	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7351	6898	7733	8078
	B. T. U. ....	13232	12416	13919	14540
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6982	.....	.....
	B. T. U. ....	.....	12568	.....	.....

## DAVIESS COUNTY.

No. 9.

Laboratory number .....18,958  
 Operator .....George Rudy  
 Mine (shaft) .....George Rudy  
 Location .....3 miles west of Owensboro  
 Location in mine.....Face of No. 6, north entry,  
 2,000 feet from shaft.

Coal ..... No. 9  
 Date of sampling .....3-23-'14  
 Date of analysis .....4-6-'14

Air-dry Loss, 3.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.85	12.08	.....	.....
	Volatile matter ..	37.95	36.61	41.64	46.14
	Fixed carbon .....	44.32	42.74	48.61	53.86
	Ash .....	8.88	8.57	9.75	.....
		100.00	100.00	100.00	100.00
Sulphur		2.90	2.80	3.18	3.52
Calorific Value Determined	Calories .....	6520	6289	7153	7926
	B. T. U. ....	11736	11320	12875	14267

## DAVIESS COUNTY.

## No. 10.

Laboratory number .....18,959  
 Operator .....George Rudy  
 Mine (shaft) .....George Rudy  
 Location .....3 miles west of Owensboro  
 Location in mine .....Face of room 15, 5th north,  
 2,200 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling .....3-23-'14  
 Date of analysis .....4-6-'14

Air-dry Loss, 3.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.30	11.45	.....	.....
	Volatile matter ..	37.90	36.60	41.33	46.76
	Fixed carbon ..	43.15	41.67	47.06	53.24
	Ash ..	10.65	10.28	11.61	.....
		100.00	100.00	100.00	100.00
Sulphur		3.06	2.96	3.34	3.78
Calorific Value Determined	Calories .....	6385	6166	6963	7877
	B. T. U. ....	11493	11099	12533	14179

## DAVIESS COUNTY.

## No. 11.

Laboratory number .....18,960  
 Operator .....George Rudy  
 Mine (shaft) .....George Rudy  
 Location .....3 miles west of Owensboro  
 Location in mine .....Face of main west entry,  
 1,800 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling .....3-23-'14  
 Date of analysis .....4-6-'14

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.53	12.09	.....	.....
	Volatile matter ..	37.25	35.80	40.72	45.72
	Fixed carbon .....	44.22	42.50	48.35	54.28
	Ash .....	10.00	9.61	10.93	.....
		100.00	100.00	100.00	100.00
Sulphur		4.00	3.84	4.37	4.91
Calorific Value Determined	Calories .....	6400	6151	6997	7856
	B. T. U. ....	11520	11071	12595	14141

## DAVIESS COUNTY.

No. 12.

Laboratory number . . . . . 18961F  
 Operator . . . . . George Rudy  
 Mine (shaft) . . . . . George Rudy  
 Location . . . . . 3 miles west of Owensboro  
 Coal . . . . . No. 9  
 Date of sampling . . . . . 3-23-'14  
 Date of analysis . . . . . 4-8-'14

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.53	11.84	.....	.....
	Volatile matter ..	38.17	36.79	41.73	46.70
	Fixed carbon .....	43.57	41.99	47.63	53.30
	Ash .....	9.73	9.38	10.64	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.27	5.48	4.72	5.28
	Carbon .....	64.44	62.11	70.45	78.84
	Nitrogen .....	1.42	1.37	1.55	1.73
	Oxygen .....	15.77	18.41	8.95	10.02
	Sulphur .....	3.37	3.25	3.69	4.13
	Ash .....	9.73	9.38	10.64	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6428	6195	7027	7864
	B. T. U. ....	11570	11151	12649	14155
Calorific Value Calculated From Ultimate Analysis			6187	.....	.....
			11137	.....	.....

## DAVIESS COUNTY.

No. 13.

Laboratory number . . . . . 18,970  
 Operator . . . . . Owen Fulkerson, Owensboro, Ky.  
 Mine (drift) . . . . . Fulkerson  
 Coal . . . . . No. 9  
 Location . . . . . 3 miles N. W. of Owensboro  
 Location in mine. . . . . No. 2 room off main entry,  
 800 feet from mouth.  
 Date of sampling . . . . . 3-24-'14  
 Date of analysis . . . . . 4-4-'14

## SECTION OF MINE.

Fossil Bearing Shale		Feet	Inches
Black Slate		1	0
1. Coal, very hard, much sulphur.....			8
2. Coal streaked with sulphur.....		1	3
3. Coal .....		1	1
4. Sulphur band, persistent.....			¾
5. Coal, soft .....		1	6¾
Total .....		4	6½
Floor—soft fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.70	10.94	.....	.....
	Volatile matter ..	38.20	36.86	41.39	47.48
	Fixed carbon .....	42.25	40.77	45.78	52.52
	Ash .....	11.85	11.43	12.83	.....
		100.00	100.00	100.00	100.00
Sulphur		4.01	3.87	4.35	4.99
Calorific Value Determined	Calories .....	6285	6064	6809	7611
	B. T. U. ....	11313	10915	12256	14060

## DAVIESS COUNTY.

## No. 14.

Laboratory number .....18,971  
 Operator .....Owen Fulkerson, Owensboro, Ky.  
 Mine (drift) .....Fulkerson  
 Coal .....No. 9  
 Location .....3 miles N. W. of Owensboro  
 Location in mine.....No. 1 room off main entry,  
 800 feet from mouth of slope.  
 Date of sampling .....3-24-'14  
 Date of analysis .....4-15-'14

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal, very hard with sulphur streaks.....			■
2. Coal, softer with thin sulphur streaks .....		3	10½
Total .....		4	6½
Floor—fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.65	12.38	.....	.....
	Volatile matter ..	38.45	36.48	41.63	47.05
	Fixed carbon .....	43.25	41.04	46.84	52.95
	Ash .....	10.65	10.10	11.53	.....
		100.00	100.00	100.00	100.00

Sulphur		3.94	3.74	4.27	4.83
Calorific Value Determined	Calories .....	6397	6069	6927	7830
	B. T. U.....	11515	10924	12469	14094

## DAVIESS COUNTY.

## No. 15.

Laboratory number .....18,972  
 (Composite of 18970 and 18971.)  
 Operator .....Owen Fulkerson  
 Mine (drift) .....Fulkerson  
 Coal .....No. 9  
 Location .....3 miles N. W. of Owensboro  
 Date of analysis .....4-15-'14

Air-dry Loss, 4.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.58	11.57	.....	.....
	Volatile matter ..	38.12	36.47	41.24	46.96
	Fixed carbon .....	43.05	41.20	46.59	53.04
	Ash .....	11.25	10.76	12.17	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.14	5.40	4.65	5.29
	Carbon .....	62.96	60.24	68.12	77.56
	Nitrogen .....	1.46	1.40	1.58	1.80
	Oxygen .....	15.21	18.39	9.17	10.44
	Sulphur .....	3.98	3.81	4.31	4.91
	Ash .....	11.25	10.76	12.17	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6327	6054	6846	7795
	B. T. U.....	11389	10897	12323	14031
Calorific Value Calculated From Ultimate Analysis			6021 10838	.....	.....

Laboratory number .....18,962  
 Operator .....Pittsburgh Coal Company  
 Mine (shaft) ..... No. 1  
 Location .....Baskett  
 Location in mine.....Face of main south,  
 3,000 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling .....3-25-'14  
 Date of analysis .....4-28-'14  
 Depth below surface .....140 feet

## SECTION OF MINE.

Roof—Hard Gray Shale		Feet	Inches 6
Black Slate		1	6
1. Coal .....			7
2. Sulphur parting .....			$\frac{1}{8}$
3. Coal .....	1		7
4. Sulphur band and mother coal.....			$\frac{1}{2}$
5. Coal, few sulphur streaks.....	1		6
Total .....	3		$8\frac{3}{8}$
Floor—soft fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.65	12.21	.....	.....
	Volatile matter ..	37.00	35.56	40.51	45.64
	Fixed carbon .....	44.08	42.36	48.25	54.36
	Ash .....	10.27	9.87	11.24	.....
		100.00	100.00	100.00	100.00
Sulphur		3.03	2.91	3.31	3.73
Calorific Value Determined	Calories .....	6433	6182	7042	7934
	B. T. U. ....	11579	11128	12676	14281

Laboratory number .....18,963  
 Operator .....Pittsburgh Coal Co.  
 Mine (shaft) ..... No. 1  
 Location .....Baskett  
 Location in mine.....Face of first west, off main south,  
 1,400 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling .....3-25-'14  
 Date of analysis .....4-8-'14  
 Depth below surface .....140 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal .....			8
2. Sulphur band, irregular .....			1
3. Coal .....			5
4. Mother coal .....			$\frac{1}{4}$
5. Coal streaked with sulphur.....		1	
6. Mother coal mixed with coal.....			4
7. Coal streaked with sulphur .....		1	4
Total .....		3	10 $\frac{1}{4}$
Floor—fire clay.			
Excluded from sample, No. 2.			

Air-dry Loss, 2.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.30	10.12		
	Volatile matter ..	36.43	35.71	39.73	45.47
	Fixed carbon .....	43.69	42.82	47.64	54.53
	Ash .....	11.58	11.35	12.63	
		100.00	100.00	100.00	100.00
Sulphur		2.93	2.87	3.19	3.65
Calorific Value Determined	Calories .....	6359	6233	6935	7938
	B. T. U. ....	11446	11219	12483	14288

## HENDERSON COUNTY.

No. 18.

Laboratory number . . . . . 18,964  
 Operator . . . . . Pittsburgh Coal Co.  
 Mine (shaft) . . . . . No. 1  
 Location . . . . . Baskett  
 Location in mine . . . . . Face of room 29, off 2nd east south,  
 3,500 feet from shaft.  
 Coal . . . . . No. 9  
 Date of sampling . . . . . 3-25-'14  
 Date of analysis . . . . . 4-8-'14  
 Depth below surface . . . . . 140 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 8
1. Coal			7
2. Sulphur band			$\frac{1}{4}$
3. Coal with mother coal and sulphur streak	1		
4. Coal	2		$2\frac{3}{4}$
Total	3		10
Floor—fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	8.18	10.36		
	Volatile matter	38.20	37.29	41.60	46.60
	Fixed carbon	43.77	42.73	47.67	53.40
	Ash	9.85	9.62	10.73	
		100.00	100.00	100.00	100.00

Sulphur		2.67	2.61	2.91	3.26
Calorific Value Determined	Calories	6488	6334	7066	7915
	B. T. U.	11678	11401	12719	14247

## HENDERSON COUNTY.

No. 19.

Laboratory number . . . . . 18,965  
 Operator . . . . . Pittsburgh Coal Co.  
 Mine (shaft) . . . . . No. 1  
 Location . . . . . Baskett  
 Location in mine . . . . . Face of main north,  
 2,600 feet from shaft.  
 Coal . . . . . No. 9  
 Date of sampling . . . . . 3-25-'14  
 Date of analysis . . . . . 4-8-'14  
 Depth below surface . . . . . 140 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal .....		1	1
2. Sulphur and mother coal .....			$\frac{1}{2}$
3. Coal with sulphur streaks .....		1	4
4. Sulphur band .....			$\frac{3}{8}$
5. Coal .....		1	$3\frac{1}{2}$
Total .....		3	9
Floor—fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.83	11.38	.....	.....
	Volatile matter ..	38.22	36.75	41.47	46.40
	Fixed carbon .....	44.15	42.45	47.90	53.60
	Ash .....	9.80	9.42	10.63	.....
		100.00	100.00	100.00	100.00
Sulphur		3.67	3.53	3.98	4.45
Calorific Value Determined	Calories .....	6524	6273	7078	7920
	B. T. U. ....	11743	11291	12740	14256

## HENDERSON COUNTY.

## No. 20.

Laboratory number .....18,966F  
 (Composite of Nos. 18962-63-64-65.)  
 Operator .....Pittsburgh Coal Co.  
 Mine (shaft) ..... No. 1  
 Location ..... Baskett  
 Coal ..... No. 9  
 Date of analysis ..... 4-9-'14

Air-dry Loss, 3.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.27	11.05	.....	.....
	Volatile matter ..	37.46	36.32	40.83	46.03
	Fixed carbon .....	43.92	42.59	47.88	53.97
	Ash .....	10.35	10.04	11.29	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.33	5.51	4.81	5.42
	Carbon .....	64.56	62.60	70.37	79.33
	Nitrogen .....	1.39	1.35	1.52	1.71
	Oxygen .....	15.19	17.42	8.55	9.64
	Sulphur .....	3.18	3.08	3.46	3.90
	Ash .....	10.35	10.04	11.29	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6453	6257	7034	7929
	B. T. U. ....	11615	11263	12661	14272
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6275	.....	.....
	B. T. U. ....	.....	11295	.....	.....

## HENDERSON COUNTY.

## No. 21.

Laboratory number .....18,973  
 Operator .....J. L. Nicholson  
 Mine (shaft) .....Nicholson  
 Location .....1½ miles S. of Henderson  
 Location in mine ..... Room 4, second west entry,  
 1,250 feet from shaft.  
 Coal ..... No 9  
 Date of sampling ..... 3-25-'14  
 Date of analysis ..... 4-9-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof-Black Slate		Feet 1	Inches 6		
Coal—Medium Hard		4	½		
Total		4	½		
Floor—fire clay. Excluded from analysis, none.					
Air-dry Loss, 4.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	6.75	11.27	...	...
	Volatile matter ..	38.42	36.56	41.20	46.82
	Fixed carbon .....	43.63	41.51	46.79	53.18
	Ash .....	11.20	10.66	12.01	...
		100.00	100.00	100.00	100.00
Sulphur		3.02	2.87	3.23	3.67
Calorific Value Determined	Calories .....	6491	6176	6960	7910
	B. T. U. ....	11684	11117	12528	14238

## HENDERSON COUNTY.

No. 22.

Laboratory number .....18,974  
 Operator .....J. L. Nicholson  
 Mine (shaft) .....Nicholson  
 Location .....1½ miles S. of Henderson  
 Location in mine.....Face of first west entry,  
                                     1,250 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....3-25-'14  
 Date of analysis .....4-9-'14  
 Depth below surface .....200 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal			7
2. Sulphur lens			1/4
3. Coal			8
4. Sulphur band			2 1/2
5. Coal		2	8
Total		4	1 3/4
Floor—fire clay.			
Excluded from sample, No. 4.			

Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	7.00	11.77		
	Volatile matter	38.42	36.45	41.31	47.27
	Fixed carbon	42.86	40.66	46.09	52.73
	Ash	11.72	11.12	12.60	
		100.00	100.00	100.00	100.00
Sulphur		3.60	3.42	3.88	4.44
Calorific Value Determined	Calories	6418	6089	6901	7896
	B. T. U.	11552	10960	12422	14213

## HENDERSON COUNTY.

No. 23.

Laboratory number .....18,975  
                                     (Composite of 18973-74.)  
 Operator .....J. L. Nicholson  
 Mine (shaft) .....Nicholson  
 Location .....1½ miles S. of Henderson  
 Coal .....No. 9  
 Date of analysis .....4-10-'14

Air-dry Loss, 5.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	6.90	11.55		
	Volatile matter ..	38.05	36.15	40.87	46.56
	Fixed carbon ..	43.67	41.49	46.91	53.44
	Ash .....	11.38	10.81	12.22	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen ..	5.12	5.41	4.67	5.32
	Carbon ..	64.52	61.30	69.31	78.96
	Nitrogen .....	1.48	1.41	1.59	1.81
	Oxygen .....	14.15	17.89	8.61	9.81
	Sulphur .....	3.35	3.18	3.60	4.10
	Ash .....	11.38	10.81	12.22	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6454	6132	6933	7898
	B. T. U. ....	11617	11038	12479	14216
Calorific Value Calculated From Ultimate Analysis	Calories ..		6117		
	B. T. U. ....		11010		

## HENDERSON COUNTY.

No. 24.

Laboratory number ..... 18,976  
 Operator ..... Panama Coal Company  
 Mine (shaft) ..... Panama  
 Location .....  $\frac{3}{4}$  mile S. of Robards  
 Location in mine ..... Face of room 27, off third south entry,  
 1,800 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 3-26-'14  
 Date of analysis ..... 5-6-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches 6
1. Soft coal with sulphur streaks.....		1	
2. Hard coal with sulphur streaks.....		3	2½
Total .....		4	2½
Floor—hard fire clay. Excluded from sample, none.			

Air-dry Loss, 4.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.90	9.90	.....	.....
	Volatile matter ..	38.15	36.53	40.54	45.49
	Fixed carbon .....	45.72	43.77	48.58	54.51
	Ash .....	10.23	9.80	10.88	.....
		100.00	100.00	100.00	100.00
Sulphur		3.50	3.35	3.72	4.17
Calorific Value Determined	Calories .....	6639	6357	7056	7918
	B. T. U. ....	11950	11443	12701	14252

## HENDERSON COUNTY.

No. 25.

Laboratory number ..... 18,977  
 Operator ..... Panama Coal Company  
 Mine (shaft) ..... Panama  
 Locality .....  $\frac{3}{4}$  miles south of Robards  
 Location in mine ..... Face of 3rd north,  
 1,600 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 3-26-'14  
 Date of analysis ..... 5-6-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches 6
1. Coal			3
2. Hard coal			11
3. Mother coal			$\frac{1}{4}$
4. Soft coal		2	$1\frac{1}{2}$
5. Sulphur			2
6. Hard coal with sulphur streaks			$3\frac{1}{2}$
7. Bottom coal			3
Total		4	$0\frac{1}{4}$
Floor—soft fire clay.			
Excluded from sample, Nos. 1-5-7.			

Air-dry Loss, 4.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	5.42	9.57		
	Volatile matter	39.28	37.56	41.53	47.16
	Fixed carbon	44.00	42.07	46.53	52.84
	Ash	11.30	10.80	11.94	
		100.00	100.00	100.00	100.00

Sulphur		4.27	4.07	4.51	5.12
Calorific Value Determined	Calories	6460	6176	6829	7755
	B. T. U.	11628	11117	12292	13959

## HENDERSON COUNTY.

No. 26.

Laboratory number . . . . .18,978  
 (Composite of 18976-77.)  
 Operator . . . . .Panama Coal Company  
 Mine (shaft) . . . . .Panama  
 Location . . . . . $\frac{1}{2}$  mile south of Robards  
 Coal . . . . .No. 11  
 Date of analysis . . . . .5-6-'14

Air-dry Loss, 4.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.60	9.68	.....	.....
	Volatile matter ..	38.68	37.01	40.98	46.25
	Fixed carbon .....	44.97	43.02	47.63	53.75
	Ash .....	10.75	10.29	11.39	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.05	5.31	4.68	5.28
	Carbon .....	65.02	62.21	68.88	77.73
	Nitrogen .....	1.48	1.42	1.57	1.77
	Oxygen .....	13.77	17.01	9.32	10.53
	Sulphur .....	3.93	3.76	4.16	4.69
	Ash .....	10.75	10.29	11.39	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6537	6255	6929	7816
	B. T. U. ....	11767	11259	12467	14069
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6207	.....	.....
	B. T. U. ....	.....	11173	.....	.....

## HENDERSON COUNTY.

No. 27.

Laboratory number . . . . .19,103  
 Operator . . . . .Corydon Coal Company  
 Mine (shaft) . . . . .Corydon Coal Company  
 Coal . . . . .Baker. (Local No. 12.)  
 Location . . . . .1,000 feet from R. R. Station at Corydon  
 Location in mine . . . . .Face of No. 8 room, second south entry,  
 1,000 feet from shaft.  
 Date of sample . . . . .4-6-'14  
 Date of analysis . . . . .4-22-'14  
 Depth below surface . . . . .185 feet

## SECTION OF MINE.

Roof--Gray Shale		Feet	Inches
1. Coal .....		1	8¼
2. Sulphur ball .....			2
3. Coal .....		1	2½
4. Sulphur ball .....			2
5. Coal .....		1	7
Total .....		4	9¾
Floor--shaly fire clay.			
Excluded from sample, Nos. 2 and 4.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.08	12.13	.....	.....
	Volatile matter ..	37.37	35.34	40.22	46.24
	Fixed carbon .....	43.45	41.09	46.76	53.76
	Ash .....	12.10	11.44	13.02	.....
		100.00	100.00	100.00	100.00

Sulphur		3.47	3.28	3.73	4.29
Calorific Value Determined	Calories .....	6312	5969	6793	7810
	B. T. U. ....	11362	10744	12227	14058

## HENDERSON COUNTY.

No. 28.

Laboratory number .....19,104  
 Operator .....Corydon Coal Company  
 Mine (shaft) .....Corydon Coal Company  
 Coal .....Baker. (Local No. 12.)  
 Location .....1,000 feet south of station at Corydon  
 Location in mine.....Face of No. 8 room, off second north entry,  
 1,000 feet from shaft.  
 Date of sample .....4-6-'14  
 Date of analysis .....4-22-'14  
 Depth below surface .....185 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches		
Gray Shale and Draw Slate			5 to 12		
1. Coal		2	11		
2. Mother Coal			1½		
3. Coal		1	11½		
Total		5	0		
Floor—Shaly fire clay.					
Excluded from sample, none.					
Air-dry Loss, 6.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	5.70	11.82		
	Volatile matter	36.60	34.22	38.81	45.35
	Fixed carbon	44.10	41.24	46.77	54.65
	Ash	13.60	12.72	14.42	
		100.00	100.00	100.00	100.00
Sulphur		3.26	3.05	3.46	4.04
Calorific Value Determined	Calories	6333	5922	6716	7848
	B. T. U.	11399	10660	12089	14126

## HENDERSON COUNTY.

No. 29.

Laboratory number .....19,105  
 Operator .....Corydon Coal Company  
 Mine (shaft) .....Corydon Coal Company  
 Coal .....Baker. (Local No. 12.)  
 Location .....1,000 feet from R. R. Station at Corydon  
 Location in mine.....Face of first north entry,  
 800 feet from shaft bottom.  
 Date of sampling .....4-6-'14  
 Date of analysis .....4-22-'14  
 Depth below surface .....185 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
Draw Slate			6 to 12
1. Coal			4½
2. Sulphur band			1½
3. Coal			6½
4. Mother coal			½
5. Coal		2	6½
6. Sulphur band			1
7. Coal		1	2
Total		4	10½
Floor—soft fire clay.			
Excluded from sample, Nos. 2 and 6.			

Air-dry Loss, 4.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	6.35	10.88		
	Volatile matter	38.30	36.45	40.90	45.92
	Fixed carbon	45.10	42.92	48.16	54.08
	Ash	10.25	9.75	10.94	
		100.00	100.00	100.00	100.00
Sulphur		2.71	2.58	2.90	3.26
Calorific Value Determined	Calories	6520	6204	6962	7817
	B. T. U.	11736	11167	12532	14071

## HENDERSON COUNTY.

No. 30.

Laboratory number .....19,106  
 Operator .....Corydon Coal Company  
 Mine (shaft) .....Corydon Coal Company  
 Location .....1,000 feet from R. R. Station at Corydon  
 Location in mine.....Face of 2nd south entry,  
 1,000 feet from shaft.  
 Coal .....Baker. (Local No. 12.)  
 Date of sample .....4-6-14  
 Date of analysis .....4-22-14  
 Depth below surface .....185 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
Draw Slate			6 to 12
1. Coal		3	2½
2. Mother coal, hard, thin			
3. Coal			1½
4. Hard, sulphurous mother coal			½
5. Coal			9½
6. Mother coal			½
7. Coal			4
Total		4	6½
Floor—soft fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	6.03	10.72		
	Volatile matter	37.37	35.51	39.77	45.45
	Fixed carbon	44.85	42.61	47.73	54.55
	Ash	11.75	11.16	12.50	
		100.00	100.00	100.00	100.00
Sulphur		3.24	3.08	3.45	3.94
Calorific Value Determined	Calories	6435	6114	6848	7827
	B. T. U.	11533	11005	12326	14089

## HENDERSON COUNTY.

No. 31.

Laboratory number .....19,107F  
 (Composite of 19103-4-5-6.)  
 Operator .....Corydon Coal Company  
 Mine (shaft) .....Corydon Coal Company  
 Location .....1,000 feet from station at Corydon  
 Depth below surface .....185 feet

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	6.18	11.28		
	Volatile matter	37.77	35.72	40.26	46.19
	Fixed carbon	44.00	41.61	46.90	53.81
	Ash	12.05	11.39	12.84	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen	5.00	5.33	4.60	5.28
	Carbon	64.33	60.83	68.55	78.65
	Nitrogen	1.47	1.39	1.57	1.80
	Oxygen	14.04	18.12	9.13	10.47
	Sulphur	3.11	2.94	3.31	3.80
	Ash	12.05	11.39	12.84	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories	6402	6054	6823	7828
	B. T. U.	11524	10897	12281	14090
Calorific Value Calculated From Ultimate Analysis	Calories		6036		
	B. T. U.		10865		

## HENDERSON COUNTY.

No. 32.

Laboratory number .....19,108  
 Operator .....Smith Mills Coal and Mining Co.  
 Mine (shaft) .....Smith Mills  
 Location .....Smith Mills, 5 miles from Corydon  
 Location in mine.....Face of room 12, off 4th north,  
 1,200 feet from shaft.  
 Coal .....Baker. (Local No. 12.)  
 Date of sampling .....4-6-'14  
 Date of analysis .....4-22-'14  
 Depth below surface .....180 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
Draw Slate		2	
1. Coal left as roof.....	1	2	
2. Coal streaked with sulphur .....		11%	
3. Sulphur ball .....		3%	
4. Coal streaked with mother coal.....	3	3	
5. Clay parting (not persistent) .....		%	
6. Coal .....		9	
Total .....	6	6	
Floor—soft, shaly fire clay, 3 feet. Excluded from sample, Nos. 1 and 3.			

Air-dry Loss, 4.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.85	13.30		
	Volatile matter ..	34.15	32.48	37.46	42.07
	Fixed carbon .....	47.02	44.73	51.59	57.93
	Ash .....	9.98	9.49	10.95	
		100.00	100.00	100.00	100.00
Sulphur		2.12	2.02	2.33	2.62
Calorific Value Determined	Calories .....	6348	6038	6964	7821
	B. T. U. ....	11426	10868	12535	14078

## HENDERSON COUNTY.

No. 33.

Laboratory number .....19,109  
 Operator .....Smith Mills Coal and Mining Co.  
 Mine (shaft) .....Smith Mills  
 Location .....Smith Mills, 5 miles from Corydon  
 Location in mine.....Face of room 11, off 3rd north,  
 1,100 feet from shaft.  
 Coal .....Baker. (Local No. 12.)  
 Date of sampling .....4-6-'14  
 Date of analysis .....4-22-'14  
 Depth below surface .....180 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
Draw Slate		1	0
1. Coal left as roof.....	1	6	
2. Coal .....	3	1¼	
3. Mother coal .....		¼	
4. Coal .....		2	
5. Mother coal .....		¾	
6. Coal streaked with mother coal.....	1	8½	
Total .....	6	6¼	
Floor—soft, shaly fire clay, 3 feet.			
Excluded from sample, No. 1.			

Air-dry Loss, 6.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	6.52	12.60		
	Volatile matter ..	35.18	32.89	37.63	41.63
	Fixed carbon .....	49.32	46.11	52.76	58.37
	Ash .....	8.98	8.40	9.61	
		100.00	100.00	100.00	100.00
Sulphur		1.89	1.77	2.03	2.25
Calorific Value Determined	Calories .....	6637	6206	7101	7856
	B. T. U. ....	11947	11171	12782	14141

## HENDERSON COUNTY.

No. 34.

Laboratory number .....19,110  
 Operator .....Smith Mills Coal and Mining Co.  
 Mine (shaft) .....Smith Mills  
 Location .....Smith Mills, 5 miles from Corydon  
 Location in mine .....Face of room 4, off west entry,  
 1,200 feet from shaft.  
 Coal .....Baker. (Local No. 12.)  
 Date of sampling .....4-6-'14  
 Date of analysis .....4-23-'14  
 Depth below surface .....180 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
Draw Slate			6 to 12
1. Coal left as roof.....	1	6	
2. Coal .....		8	
3. Thin sulphur band.....			
4. Coal .....		1	
5. Sulphur band .....		½	
6. Coal .....	3	11	
7. Thin lens of mother coal. ....			
8. Coal .....		10	
Total .....	7	0½	
Floor—shaly fire clay.			
Excluded from sample, No. 1.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.38	13.35		
	Volatile matter ..	36.02	34.06	39.31	43.08
	Fixed carbon .....	47.60	45.02	51.95	56.92
	Ash .....	8.00	7.57	8.74	
		100.00	100.00	100.00	100.00
Sulphur		1.79	1.69	1.95	2.14
Calorific Value Determined	Calories .....	6602	6244	7206	7896
	B. T. U. ....	11884	11239	12971	14213

## HENDERSON COUNTY.

No. 35.

Laboratory number .....19,111  
 Operator .....Smith Mills Coal and Mining Company  
 Mine (shaft) .....Smith Mills  
 Location .....Smith Mills, 5 miles from Corydon  
 Location in mine .....Face of room 5, off main north entry,  
 1,200 feet from shaft.  
 Coal .....Baker. (Local No. 12.)  
 Date of sampling .....4-6-'14  
 Date of analysis .....4-23-'14  
 Depth below surface .....180 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1.	Coal left as roof . . . . .	1	8
2.	Coal . . . . .	1	1½
3.	Thin mother coal and sulphur . . . . .		
4.	Coal containing disseminated sulphur . . . . .		4
5.	Coal . . . . .		7
6.	Mother coal . . . . .		½
7.	Coal . . . . .	1	9½
8.	Mother coal . . . . .		½
9.	Coal . . . . .	1	5
Total . . . . .		7	0
Floor—shaly fire clay.			
Excluded from sample, No. 1.			

Air-dry Loss, 5.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture . . . . .	8.13	12.74		
	Volatile matter . . . . .	34.77	33.02	37.84	41.29
	Fixed carbon . . . . .	49.42	46.95	53.81	58.71
	Ash . . . . .	7.68	7.29	8.35	
		100.00	100.00	100.00	100.00
Sulphur . . . . .		1.64	1.56	1.79	1.95
Calorific Value Determined	Calories . . . . .	6657	6323	7246	7906
	B. T. U. . . . .	11983	11381	13043	14231

## HENDERSON COUNTY.

No. 36.

Laboratory number .....19,112  
 (Composite of 19,108-9-10-11.)  
 Operator.....Smith Mills Coal and Mining Co.  
 Mine .....Smith Mills  
 Location .....Smith Mills, 5 miles from Corydon  
 Coal .....Baker. (Local No. 12.)  
 Date of analysis .....4-24-'14

Air-dry Loss, 5.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.93	12.96	.....	.....
	Volatile matter ..	35.32	33.39	38.36	42.38
	Fixed carbon .....	48.02	45.40	52.16	57.62
	Ash .....	8.73	8.25	9.48	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen . . .	5.14	5.47	4.63	5.12
	Carbon .....	66.53	62.90	72.27	79.85
	Nitrogen .....	1.52	1.44	1.65	1.82
	Oxygen .....	16.18	20.14	9.90	10.92
	Sulphur .....	1.90	1.80	2.07	2.29
		8.73	8.25	9.48	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6587	6227	7154	7904
	B. T. U. . . . .	11857	11209	12877	14227
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6139	.....	.....
	B. T. U. . . . .	.....	11050	.....	.....

## HOPKINS COUNTY.

No. 37.

Laboratory number .....19,194  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location.....1 mile west of Madisonville  
 Location in mine . . . . .Face of 8th west off main north,  
 1½ miles from shaft.  
 Coal .....No. 11  
 Date of sampling .. . . . .4-16-'14  
 Date of analysis .....5-26-'14

## SECTION OF MINE.

Roof—Hard Black Slate Under Limestone		Feet	Inches
1. Coal .....		1	5
2. Sulphur and clay band.....			1
3. Coal streaked with mother coal .....	2		
4. Sulphur band .....			1½
5. Coal streaked with mother coal .....			9
6. "Blue band" .....			2
7. Coal .....			2½
8. Sulphur band .....			¼
9. Coal streaked with sulphur.....			9¼
10. Mother coal .....			¼
11. Coal streaked with sulphur.....	1		1
Total .....		6	6¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 2-4-6.			

Air-dry Loss 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.39	6.53		
	Volatile matter ..	41.01	39.68	42.45	46.09
	Fixed carbon .....	47.98	46.42	49.66	53.91
	Ash .....	7.62	7.37	7.89	
		100.00	100.00	100.00	100.00

Sulphur		3.88	3.75	4.01	4.35
Calorific Value Determined	Calories .....	7176	6943	7428	8065
	B. T. U. ....	12917	12497	13370	14517

## HOPKINS COUNTY.

No. 38.

Laboratory number .....19,195  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile W. of Madisonville  
 Location in mine.....Face of 10th west,  
                                     1½ miles from shaft.  
 Coal .....No. 11  
 Date of sampling . . . . .4-16-'14  
 Date of analysis . . . . .6-1-'14  
 Depth below surface . . . . .265 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches		
Black Slate			6		
1. Coal .....		1	2%		
2. Sulphur and clay band.....			%		
3. Coal .....		1	8½		
4. Mother coal .....			½		
5. Coal streaked with mother coal.....			11½		
6. "Blue band" .....			2		
7. Coal mixed with sulphur.....		1	4		
8. Coal high in sulphur..			8½		
Total .....		6	2½		
Floor—hard, smooth fire clay.					
Excluded from sample, Nos. 2-6-8.					
Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.21	6.34		
	Volatile matter ..	41.19	39.86	42.56	46.59
	Fixed carbon .....	47.22	45.69	48.78	53.41
	Ash .....	8.38	8.11	8.66	
		100.00	100.00	100.00	100.00
Sulphur		3.85	3.73	3.98	4.36
Calorific Value Determined	Calories ..	7114	6884	7350	8047
	B. T. U. .	12805	12391	13230	14485

## HOPKINS COUNTY.

No. 39.

Laboratory number .....19,196  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile W. of Madisonville  
 Location in mine.....Face of room 15 off 5th west,  
                                     1½ miles from shaft.  
 Coal .....No. 11  
 Date of sampling . . . . .4-16-'14  
 Date of analysis . . . . .5-26-'14  
 Depth below surface . . . . .265 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Black Slate			
1. Coal		1	1
2. Mother coal			¾
3. Coal			5½
4. Thin sulphur lens			
5. Coal		2	10
6. "Blue band"			2½
7. Coal with irregular sulphur bands		1	10
Total		6	5¼
Floor—hard, smooth fire clay.			
Excluded from sample, No. 6.			

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.27	5.92		
	Volatile matter	42.18	41.02	43.60	47.52
	Fixed carbon	46.57	45.30	48.15	52.48
	Ash	7.98	7.76	8.25	
		100.00	100.00	100.00	100.00
Sulphur		3.53	3.43	3.65	3.98
Calorific Value Determined	Calories	7166	6970	7408	8074
	B. T. U.	12899	12546	13334	14533

## HOPKINS COUNTY.

No. 40.

Laboratory number .....19,197  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile W. of Madisonville  
 Location in mine.....Face of main north,  
                                     1¼ miles from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-16-'14  
 Date of analysis.....5-26-'14  
 Depth below surface .....265 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Black Slate			
1. Coal		1	4
2. Sulphur band			½
3. Coal mixed with sulphur		2	5½
4. Sulphur band			¾
5. Coal			3¾
6. "Blue band"			1¾
7. Coal			1¼
8. Sulphur band			¼
9. Coal mixed with sulphur			7
10. Sulphur and coal mixed			5
11. Coal mixed with sulphur			5½
12. Bottom coal			6
Total		6	5
Floor—coal.			
Excluded from sample, Nos. 2-6-7-8-10-12.			

Air-dry Loss, 2.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.20	5.43		
	Volatile matter	41.20	40.25	42.56	45.80
	Fixed carbon	48.75	47.63	50.37	54.20
	Ash	6.85	6.69	7.07	
		100.00	100.00	100.00	100.00
Sulphur		3.53	3.45	3.65	3.93
Calorific Value Determined	Calories	7254	7087	7494	8064
	B. T. U.	13057	12757	13489	14515

## HOPKINS COUNTY.

No. 41.

Laboratory number .....19,198  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile W. of Madisonville  
 Location in mine.....Rib face of 12th west, junction of 1st south,  
                                     1¼ miles from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-16-'14  
 Date of analysis.....5-27-'14  
 Depth below surface .....265 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Black Slate		1	
1. Coal		1	1
2. Sulphur lens			½
3. Coal			1½
4. Sulphur band			½
5. Coal		2	10
6. "Blue band"			2
7. Coal, thin sulphur band 1½ from top			10½
8. Mother coal			½
9. Coal			6½
10. Thin sulphur band			
11. Coal			9½
Total		6	6½
Floor—hard, smooth fire clay.			
Excluded from sample, No. 6.			

Air-dry Loss, 3.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.67	6.53		
	Volatile matter	40.33	39.13	41.87	46.39
	Fixed carbon	46.62	45.24	48.39	53.61
	Ash	9.38	9.10	9.74	
		100.00	100.00	100.00	100.00
Sulphur		4.30	4.17	4.46	4.94
Calorific Value Determined	Calories	6968	6761	7234	8015
	B. T. U.	12542	12170	13021	14427

## HOPKINS COUNTY.

No. 42.

Laboratory number ..... 19,199  
 Operator..... Reinecke Coal Mining Co.  
 Mine (shaft) ..... Reinecke  
 Location ..... 1 mile W. of Madisonville  
 Location in mine..... Room 1 off 16 east, main south,  
 2 miles from shaft.  
 Coal ..... No. 11  
 Date of sampling ..... 4-17-'14  
 Date of analysis ..... 5-27-'14  
 Depth below surface ..... 265 feet

## SECTION OF MINE.

Roof--Black Slate	Feet	Inches
1. Coal with sulphur streaks.....	1	2½
2. Sulphur and clay band.....		1
3. Coal streaked with mother coal.....	2	2¾
4. Mother coal .....		½
5. Coal .....		3
6. Sulphur band .....		¼
7. Coal .....		3¾
8. "Blue band" .....		2½
9. Coal .....	1	7
10. Bottom coal filled with sulphur.....		3½
Total .....	6	2¾
Floor—hard, smooth fire clay. Excluded from sample, Nos. 2-8 10.		

Air-dry Loss, 3.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.82	7.15		
	Volatile matter ..	41.28	39.85	42.92	45.59
	Fixed carbon .....	49.26	47.56	51.22	54.41
	Ash .....	5.64	5.44	5.86	
		100.00	100.00	100.00	100.00
Sulphur		3.44	3.32	3.58	3.80
Calorific Value Determined	Calories .....	7292	7040	7582	8054
	B. T. U. ....	13126	12672	13648	14497

## HOPKINS COUNTY.

No. 43.

Laboratory number ..... 19,200  
 Operator..... Reinecke Coal Mining Co.  
 Mine (shaft) ..... Reinecke  
 Location ..... 1 mile west of Madisonville  
 Location in mine..... Face of room 8 off 16 E., air course,  
 1¼ miles S. W. from shaft.  
 Coal ..... No. 11  
 Date of sampling ..... 4-17-'14  
 Date of analysis ..... 5-27-'14  
 Depth below surface ..... 265 feet

## SECTION OF MINE.

Roof--Black Slate	Feet	Inches 4 to 48
1. Coal adhering to roof.....		1
2. Coal .....	1	2
3. Hard sulphur band.....		1
4. Coal .....	2	8¼
5. "Blue band" .....		2
6. Coal .....		3
7. Sulphur and mother coal.....		¼
8. Coal .....	1	
9. Thin sulphur band .....		
10. Coal containing sulphur .....		7
Total .....	6	½
Floor—hard, smooth fire clay. Excluded from sample, Nos. 1-3-5.		

Air-dry Loss, 2.9.		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture . . . . .	3.19	6.04		
	Volatile matter ..	41.91	40.68	43.30	46.28
	Fixed carbon .....	48.67	47.23	50.26	53.72
	Ash .....	6.23	6.05	6.44	
		100.00	100.00	100.00	100.00
Sulphur		3.54	3.44	3.66	3.91
Calorific Value Determined	Calories .....	7301	7086	7542	8061
	B. T. U. ....	13142	12755	13576	14510

## HOPKINS COUNTY.

No. 44.

Laboratory number .....19,201  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile west of Madisonville  
 Location in mine... Rib of 6th west entry, opposite room 8,  
 1½ miles from shaft.  
 Coal ..... No. 11  
 Date of sampling .....4-16-'14  
 Date of analysis .....5-21-'14  
 Depth below surface.....265 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal		1	4½
2. Sulphur lens			1
3. Coal		1	5½
4. Mother coal			¾
5. Coal			6½
6. Sulphur band			¾
7. Coal			5½
8. Coal and sulphur			1¼
9. Coal			4
10. "Blue band"			1½
11. Coal with sulphur near bottom		2	2
Total		6	8¾
Floor—hard fire clay.			
Excluded from sample, Nos. 2-6-10.			

Air-dry Loss, 2.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.55	6.32		
	Volatile matter	41.05	39.87	42.56	45.89
	Fixed carbon	48.41	47.02	50.19	54.11
	Ash	6.99	6.79	7.25	
		100.00	100.00	100.00	100.00
Sulphur		3.94	3.83	4.09	4.41
Calorific Value Determined	Calories	7203	6996	7468	8052
	B. T. U.	12965	12593	13442	14494

## HOPKINS COUNTY.

No. 45.

Laboratory number .....19,202  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile west of Madisonville  
 Location in mine... Face of 14th west entry, at room 20,  
 2 miles from shaft.  
 Coal ..... No. 11  
 Date of sampling .....4-17-'14  
 Date of analysis .....5-21-'14  
 Depth below surface .....265 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal			10¾
2. Sulphur band			¾
3. Coal			5½
4. Mother coal			½
5. Coal		2	2½
6. Sulphur lens			2
7. Coal			4
8. "Blue band"			2½
9. Coal mixed with sulphur		1	4½
10. Sulphur band and coal			1½
11. Bottom coal			4½
Total		6	2½
Floor—hard fire clay.			
Excluded from sample, Nos. 6-8-10.			

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.20	6.94		
	Volatile matter	39.85	38.31	41.17	45.93
	Fixed carbon	46.92	45.11	48.47	54.07
	Ash	10.03	9.64	10.36	
		100.00	100.00	100.00	100.00
Sulphur		4.72	4.54	4.88	5.44
Calorific Value Determined	Calories	6954	6685	7184	8014
	B. T. U.	12515	12033	12931	14425

## HOPKINS COUNTY.

No. 46.

Laboratory number .....19,203F  
 (Composite of 19,194-95-96-97-98-99-200-01-02.)  
 Operator.....Reinecke Coal Mining Co.  
 Mine (shaft) .....Reinecke  
 Location .....1 mile W. of Madisonville  
 Coal .....No. 11  
 Date of analysis .....5-21-14

Air-dry Loss, 3.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.25	6.22	.....	.....
	Volatile matter ..	41.15	39.89	42.53	46.22
	Fixed carbon ....	47.87	46.40	49.48	53.73
	Ash ..	7.73	7.49	7.99	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen ..	5.27	5.45	5.03	5.52
	Carbon . .	71.42	69.23	73.82	80.23
	Nitrogen .....	1.35	1.31	1.40	1.52
	Oxygen .....	10.41	12.82	7.76	8.44
	Sulphur .....	3.82	3.70	3.95	4.29
	Ash .....	7.73	7.49	7.99	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7151	6931	7391	8033
	B. T. U. ....	12872	12476	13304	14459
Calorific Value Calculated From Ultimate Analysis		Calories..	7004	.....	.....
		B. T. U. ....	12607	.....	.....

## HOPKINS COUNTY.

No. 47.

Laboratory number .....19,204  
 Operator .....St. Bernard Mining Company  
 Mine (slope) .....Arnold, No. 9.  
 Location .....On L. & N. R. R., ½ mile S. E. of Earlington  
 Location in mine .....Face of main north,  
 ¾ mile from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-18-14  
 Date of analysis .....5-5-14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal .....		1	1½
2. Sulphur band .....			2
3. Coal .....			6½
4. Mother coal .....			¼
5. Coal .....			8½
6. Sulphur band .....			½
7. Coal streaked with sulphur.....		2	1¼
Total .....		4	8¼
Floor—hard, smooth fire clay. Excluded from sample, No. 2.			

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.96	8.51		
	Volatile matter ..	37.44	35.67	38.99	43.76
	Fixed carbon .....	48.13	45.85	50.11	56.24
	Ash .....	10.47	9.97	10.90	
		100.00	100.00	100.00	100.00
Sulphur		4.19	3.99	4.36	4.89
Calorific Value Determined	Calories .....	6851	6526	7133	8005
	B. T. U. ....	12332	11747	12839	14409

## HOPKINS COUNTY.

No. 48.

Laboratory number .....19,205  
 Operator .....St. Bernard Mining Company  
 Mine (slope) .....Arnold, No. 9  
 Location .....½ mile S. E. of Earlington  
 Location in mine.....Face of 7 East at room No. 100,  
                                     8,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-18-'14  
 Date of analysis .....5-5-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Coal, brittle .....		1	10½
2. Mother coal .....			¼
3. Coal streaked with mother coal.....		1	2
4. Sulphur band and coal mixed.....			½
5. Coal mixed with sulphur.....			9¼
6. Clay and sulphur band.....			¼
7. Coal mixed with sulphur.....			7½
Total .....		4	6¼
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 4.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.98	8.43	.....	.....
	Volatile matter ..	38.92	37.12	40.54	44.31
	Fixed carbon .....	48.92	46.65	50.94	55.69
	Ash .....	8.18	7.80	8.52	.....
		100.00	100.00	100.00	100.00
Sulphur		3.94	3.76	4.11	4.49
Calorific Value Determined	Calories .....	7033	6707	7325	8007
	B. T. U. ....	12659	12073	13185	14413

## HOPKINS COUNTY.

No. 49.

Laboratory number .....19,206  
 Operator .....St. Bernard Mining Company  
 Mine (slope) .....Arnold, No. 9  
 Location .....½ mile S. E. of Earlington  
 Location in mine.....Rib of 16 East entry, room No. 37,  
                                     5,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-18-'14  
 Date of analysis .....5-5-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Hard coal .....		1	9½
2. Sulphur and mother coal.....			1½
3. Hard coal .....		1	3
4. Thin sulphur band.....			
5. Hard coal .....		1	4½
Total .....		4	6½
Floor—hard, smooth fire clay.			
Excluded from sample, No. 2.			

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.13	8.65		
	Volatile matter ..	38.37	36.56	40.02	44.49
	Fixed carbon .....	47.87	45.61	49.93	55.51
	Ash .....	9.63	9.18	10.05	
		100.00	100.00	100.00	100.00

Sulphur		3.40	3.24	3.55	3.95
Calorific Value Determined	Calories .....	6910	6585	7209	8014
	B. T. U. ....	12438	11853	12976	14425

## HOPKINS COUNTY.

No. 50.

Laboratory number ..... 19,207  
 Operator ..... St. Bernard Mining Company  
 Mine (slope) ..... Arnold, No. 9  
 Location ..... ½ mile S. E. of Earlington  
 Location in mine ..... Face of room 39 off 13th east,  
 5,000 feet from entrance.  
 Coal ..... No. 9  
 Date of sampling ..... 4-18-'14  
 Date of analysis ..... 5-5-'14  
 Depth below surface ..... 100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
Immediate Roof—Black Slate		2	
1. Hard coal .....		1	2
2. Sulphur band .....			½
3. Hard coal .....		2	3½
4. Thin sulphur band .....			
5. Hard coal .....		1	
Total .....		4	6
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 4.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.04	8.66		
	Volatile matter ..	38.06	36.23	39.66	44.32
	Fixed carbon .....	47.80	45.50	49.82	55.68
	Ash .....	10.10	9.61	10.52	
		100.00	100.00	100.00	100.00
Sulphur		3.75	3.57	3.91	4.37
Calorific Value Determined	Calories .....	6888	6557	7179	8023
	B. T. U. ....	12398	11803	12922	14441

## HOPKINS COUNTY.

No. 51.

Laboratory number ..... 19,208  
 Operator ..... St. Bernard Mining Company  
 Mine (slope) ..... Arnold, No. 9  
 Location ..... ½ mile S. E. of Earlington  
 Location in mine ..... Rib face of room 92 off 7th east entry,  
 7,500 feet from entrance.  
 Coal ..... No. 9  
 Date of sampling ..... 4-18-'14  
 Date of analysis ..... 5-6-'14

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Hard coal .....			7½
2. Sulphur band .....			½
3. Hard coal .....			7¼
4. Soft sulphur band.....			1
5. Hard coal .....	1		½
6. Sulphur band .....			½
7. Hard coal .....	2		1½
Total .....		4	6¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 2-4-6.			

Air-dry Loss, 4.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.83	8.05		
	Volatile matter ..	38.77	37.07	40.31	44.80
	Fixed carbon .....	47.77	45.67	49.67	55.20
	Ash .....	9.63	9.21	10.02	
		100.00	100.00	100.00	100.00
Sulphur		3.54	3.38	3.68	4.09
Calorific Value Determined	Calories .....	6927	6623	7203	8005
	B. T. U. ....	12469	11921	12965	14409

## HOPKINS COUNTY.

No. 52.

Laboratory number .....19,209  
 Operator .....St. Bernard Mining Company  
 Mine (slope) .....Arnold, No. 9  
 Location .....½ mile S. E. of Earlington  
 Location in mine .....Rib of 10th east entry, at room 65,  
                                     8,000 feet from surface.  
 Coal ..... No. 9  
 Date of sampling .....4-18-'14  
 Date of analysis .....5-6-'14

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Hard coal .....		1	4½
2. Soft, spar sulphur band.....			½
3. Hard coal with bands of mother coal.....		2	½
4. Thin sulphur band .....			
5. Hard coal . . . . .		1	2½
Total .....		4	8
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 5.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.91	8.67		
	Volatile matter ..	38.39	36.49	39.95	45.04
	Fixed carbon .....	46.85	44.53	48.76	54.96
	Ash .....	10.85	10.31	11.29	
		100.00	100.00	100.00	100.00
Sulphur		3.21	3.05	3.34	3.77
Calorific Value Determined	Calories .....	6843	6504	7121	8028
	B. T. U. ....	12317	11707	12818	14450

## HOPKINS COUNTY.

No. 53.

Laboratory number .....19,210  
 Operator .....St. Bernard Mining Company  
 Mine (slope) .....Arnold, No. 9  
 Location .....½ mile S. E. of Earlington  
 Location in mine .....Face of 14 East entry,  
                                     5,000 feet from entrance.  
 Coal ..... No. 9  
 Date of sampling .....4-18-'14  
 Date of analysis .....5-6-'14  
 Depth below surface . . . . . 100 feet

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Brittle coal . . . . .			5½
2. Knife-blade sulphur band . . . . .			
3. Brittle coal . . . . .			6½
4. Sulphur band . . . . .			2
5. Good coal . . . . .	1		10
6. Sulphur mixed with coal . . . . .			½
7. Coal streaked with sulphur. . . . .	1		2½
Total . . . . .		4	3
Floor—hard fire clay.			
Excluded from sample, No. 4.			

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture . . . . .	3.89	8.36		
	Volatile matter . .	38.71	36.91	40.28	44.49
	Fixed carbon . . . .	48.32	46.07	50.27	55.51
	Ash . . . . .	9.08	8.66	9.45	
		100.00	100.00	100.00	100.00

Sulphur		4.02	3.83	4.18	4.62
Calorific Value Determined	Calories . . . . .	6982	6657	7264	8022
	B. T. U. . . . .	12568	11983	13075	14440

## HOPKINS COUNTY.

No. 54.

Laboratory number ..... 19,211  
 Operator ..... St. Bernard Mining Company  
 Mine (slope) ..... Arnold, No. 9  
 Location .....  $\frac{1}{2}$  mile S. E. of Earlington  
 Location in mine ..... Face room 62, 50 feet from entry 10 East,  
 5,000 feet from entrance.  
 Coal ..... No. 9  
 Date of sampling ..... 4-18-'14  
 Date of analysis ..... 5-6-'14  
 Depth below surface ..... 100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Hard coal .....		1	5½
2. Sulphur band .....			1
3. Bright coal .....		1	10½
4. Sulphur band .....			¼
5. Coal .....		1	2½
Total .....		4	7¾
Floor—hard, smooth fire clay. Excluded from sample, No. 2.			

Air-dry Loss, 5.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.46	9.45		
	Volatile matter ..	38.39	36.39	40.19	44.37
	Fixed carbon .....	48.15	45.63	50.39	55.63
	Ash .....	9.00	8.53	9.42	
		100.00	100.00	100.00	100.00

Sulphur		2.98	2.82	3.11	3.43
Calorific Value Determined	Calories .....	6941	6579	7266	8022
	B. T. U. ....	12494	11842	13079	14440

## HOPKINS COUNTY.

No. 55.

Laboratory number ..... 19,212F  
 (Composite of 19,204-05-06-07-08-09-10-11.)  
 Operator ..... St. Bernard Mining Company  
 Mine (slope) ..... Arnold, No. 9  
 Location .....  $\frac{1}{2}$  mile S. E. of Earlington  
 Coal ..... No. 9  
 Date of analysis ..... 5-6-'14

Air-dry Loss, 4.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.97	8.54		
	Volatile matter ..	38.18	36.36	39.76	44.21
	Fixed carbon .....	48.18	45.89	50.17	55.79
	Ash .....	9.67	9.21	10.07	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.13	5.42	4.89	5.44
	Carbon .....	69.24	65.94	72.10	80.18
	Nitrogen .....	1.47	1.40	1.53	1.70
	Oxygen .....	10.84	14.55	7.60	8.44
	Sulphur .....	3.65	3.48	3.81	4.24
	Ash .....	9.67	9.21	10.07	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6932	6602	7219	8023
	B. T. U. ....	12478	11884	12994	14450
Calorific Value Calculated From Ultimate Analysis			6647		
	B. T. U. ....		11965		

## HOPKINS COUNTY.

No. 56.

Laboratory number ..... 19,230  
 Operator ..... Nebo Consolidated Coal Co.  
 Mine (slope) ..... Nebo Consolidated Coal Co.  
 Location ..... 3 miles south of Nebo  
 Location in mine ..... Last break-through, 2nd east off, north entry,  
 3,000 feet from entrance.  
 Coal ..... Baker. (Local, No. 12.)  
 Date of sampling ..... 4-15-'14  
 Date of analysis ..... 5-15-'14  
 Depth below surface ..... 100 feet

## SECTION OF MINE.

Roof—Rotten Gray Shale.		Feet	Inches
1. Top coal left as roof.....		1	6
2. Coal mixed with sulphur.....		3	10
3. Sulphur band .....			½
4. Coal with some sulphur.....			5¾
5. Dirty bottom coal .....			3
Total .....		6	1¾
Floor—soft, smooth fire clay, 2 feet.			
Excluded from sample, Nos. 1-5.			

Air-dry Loss, 6.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.62	9.41	.....	.....
	Volatile matter ..	37.58	35.32	38.99	44.96
	Fixed carbon .....	46.00	43.24	47.73	55.04
	Ash .....	12.80	12.03	13.28	.....
		100.00	100.00	100.00	100.00

Sulphur		3.97	3.73	4.12	4.75
Calorific Value Determined	Calories .....	6616	6218	6864	7915
	B. T. U. ....	11909	11192	12355	14247

## HOPKINS COUNTY.

No. 57.

Laboratory number ..... 19,231  
 Operator ..... Nebo Consolidated Coal Co.  
 Mine (slope) ..... Nebo Consolidated Coal Co.  
 Location ..... 3 miles south of Nebo  
 Location in mine ..... Face of room 15 off 1st east entry,  
 3,000 feet from entrance.  
 Coal ..... Baker. (Local, No. 12.)  
 Date of sampling ..... 4-15-'14  
 Date of analysis ..... 5-12-'14  
 Depth below surface ..... 75 feet

## SECTION OF MINE.

Roof--Rotten Gray Shale		Feet	Inches
1.	Coal left as roof.....	1	2
2.	Coal .....	1	1
3.	Thin clay parting .....		
4.	Coal .....	1	1½
5.	Thin sulphur band .....		2½
6.	Coal .....		
7.	Thin sulphur band.....		3
8.	Coal ..		½
9.	Sulphur and mother coal.....	1	9½
10.	Coal .....		7
11.	Coal high in ash .....		
Total ..		6	3
Floor--hard, smooth fire clay 12 to 18 inches. Excluded from sample, Nos. 1-11.			

Air-dry Loss, 4.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.59	8.48		
	Volatile matter ..	36.71	35.21	38.47	42.10
	Fixed carbon .....	50.47	48.42	52.91	57.90
	Ash .....	8.23	7.89	8.62	.....
		100.00	100.00	100.00	100.00
Sulphur		2.75	2.64	2.83	3.15
Calorific Value Determined	Calories .....	6942	6659	7276	7962
	B. T. U. ....	12496	11986	13097	14332

## HOPKINS COUNTY.

No. 58.

Laboratory number . . . . .19,232  
 Operator . . . . .Nebo Consolidated Coal Co.  
 Mine (slope) . . . . .Nebo Consolidated Coal Co.  
 Location . . . . .3 miles south of Nebo  
 Location in mine . . . . .Rib of room 5 off 1st north entry,  
 3,000 feet from entrance.  
 Coal . . . . .Baker. (Local No. 12.)  
 Date of sampling . . . . .4-15-'14  
 Date of analysis . . . . .5-12-'14  
 Depth below surface . . . . .80 feet

## SECTION OF MINE.

Roof—Hard, Gray Shale		Feet	Inches
1. Coal		4	7
2. Thin sulphur band			
3. Coal			2
4. Thin sulphur band			
5. Coal		1	
6. Coal high in ash and sulphur			7
Total		6	4
Floor—hard fire clay.			
Excluded from sample, No. 6.			

Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.64	7.73		
	Volatile matter	38.01	36.78	39.86	42.80
	Fixed carbon	50.80	49.15	53.27	57.20
	Ash	6.55	6.34	6.87	
		100.00	100.00	100.00	100.00
Sulphur		2.32	2.24	2.43	2.61
Calorific Value Determined	Calories	7084	6854	7428	7976
	B. T. U.	12751	12337	13370	14357

## HOPKINS COUNTY.

No. 59.

Laboratory number . . . . .19,233  
 Operator . . . . .Nebo Consolidated Coal Co.  
 Mine (slope) . . . . .Nebo Consolidated Coal Co.  
 Location . . . . .3 miles S. from Nebo  
 Location in mine . . . . .Room 2, off 3rd east, off north entry,  
 3,200 feet from entrance.  
 Coal . . . . .Baker. (Local No. 12.)  
 Date of sampling . . . . .4-15-'14  
 Date of analysis . . . . .5-21-'14  
 Depth below surface . . . . .100 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1. Top coal left as roof.....		1	...
2. Coal .....		2	1½
3. Sulphur ball . . . . .			2½
4. Coal streaked with mother coal . . . . .		2	3½
5. Coal with sulphur .. . . .			7
6. Shaly bottom coal .. . . .			3
Total .....		6	5½
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 1-3-6.			

Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.23	9.11		
	Volatile matter ..	35.92	34.09	37.51	41.94
	Fixed carbon .....	49.73	47.20	51.93	58.06
	Ash .....	10.12	9.60	10.56	
		100.00	100.00	100.00	100.00
Sulphur		3.29	3.12	3.43	3.84
Calorific Value Determined	Calories .....	6886	6535	7190	8039
	B. T. U. ....	12395	11763	12942	14470

## HOPKINS COUNTY.

No. 60.

Laboratory number .....19,234  
 Operator .....Nebo Consolidated Coal Co.  
 Mine (slope) .....Nebo Consolidated Coal Co.  
 Location .....3 miles south from Nebo  
 Location in mine..... Face of 1st west, off 1st north,  
 3,400 feet from entrance.  
 Coal ..... Baker. (Local No. 12.)  
 Date of sampling .....4-15-'14  
 Date of analysis .....5-12-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1. Coal left as roof.....		1	2
2. Coal .....		3	9½
3. Sulphur lens .....			1
4. Coal .....			9
5. Bottom coal, high in ash.....			8
Total .....		6	5½
Floor—hard fire clay. Excluded from sample, Nos. 1-3-5.			

Air-dry Loss, 4.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.91	8.81		
	Volatile matter ..	36.99	35.47	38.90	42.72
	Fixed carbon .....	49.59	47.56	52.15	57.28
	Ash .....	8.51	8.16	8.95	
		100.00	100.00	100.00	100.00

Sulphur		2.65	2.54	2.79	3.06
Calorific Value Determined	Calories .....	6919	6635	7276	7991
	B. T. U. ....	12454	11943	13097	14384

## HOPKINS COUNTY.

No. 61.

Laboratory number .....19,235  
 Operator ..... Nebo Consolidated Coal Co.  
 Mine (slope) .....Nebo Consolidated Coal Co.  
 Location .....3 miles south of Nebo  
 Location in mine.....2nd break-through,  
 40 ft. from intersection of 4th E. and N. entry intersection,  
 3,600 feet from entrance.  
 Coal ..... Baker. (Local No. 12.)  
 Date of sampling .....4-15-'14  
 Date of analysis .....5-12-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet 1	Inches
1. Top coal left as roof.....		1	.....
2. Coal .....		1	2
3. Coal with sulphur .....		.....	5
4. Coal streaked with sulphur.....		3	5
5. Shaly, bottom coal.....		.....	3
Total .....		6	3
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 1-5.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.51	9.69	.....	.....
	Volatile matter ..	37.89	35.84	39.69	42.56
	Fixed carbon .....	51.15	48.37	53.56	57.44
	Ash .....	6.45	6.10	6.75	.....
		100.00	100.00	100.00	100.00

Sulphur		2.33	2.20	2.44	2.62
Calorific Value Determined	Calories .....	7088	6704	7423	7960
	B. T. U. ....	12758	12067	13361	14328

## HOPKINS COUNTY.

No. 62.

Laboratory number .....19,236F  
 (Composite of 19,230-31-32-33-34-35.)  
 Operator.....Nebo Consolidated Coal Co.  
 Mine (slope).....Nebo Consolidated Coal Co.  
 Location .....3 miles South of Nebo  
 Coal .....Baker. (Local No. 12)  
 Date of analysis .....5-15-'14

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.39	8.85	.....	.....
	Volatile matter ..	37.01	35.29	38.72	42.62
	Fixed carbon .....	49.84	47.51	52.12	57.38
	Ash .....	8.76	8.35	9.16	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.12	5.40	4.85	5.34
	Carbon .....	70.49	67.21	73.74	81.17
	Nitrogen .....	1.60	1.53	1.68	1.85
	Oxygen .....	11.10	14.72	7.51	8.27
	Sulphur .....	2.93	2.79	3.06	3.37
	Ash .....	8.76	8.35	9.16	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6947	6623	7266	7998
	B. T. U. ....	12505	11921	13079	14396
Calorific Value Calculated From Ultimate Analysis			6720	.....	.....
			12096	.....	.....

## HOPKINS COUNTY.

No. 63.

Laboratory number .....19,237  
 Operator .....Norton Coal Mining Co.  
 Mine (shaft) .....Nortonville, No. 1  
 Location .....1,000 feet west of Nortonville  
 Location in mine .....Face of room 23, off 1st west entry,  
 2,500 feet from shaft.  
 Coal .....No 11  
 Date of sampling .....4-20 '14  
 Date of analysis .....5-22-'14  
 Depth below surface .....170 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 5	Inches
1. Coal .....		2	2½
2. Sulphur band .....			½
3. Coal streaked with mother coal .....		1	3
4. Sulphur band .....			½
5. Coal streaked with mother coal.....			7¾
6. "Blue band" .....			2¾
7. Coal .....			1
8. Sulphur band .....			¾
9. Coal streaked with mother coal.....		1	1½
10. Coal with sulphur.....			5½
11. Sulphur and coal mixed.....			4
Total .....		6	5
Floor—soft, smooth fire clay.			
Excluded from sample, Nos. 2-4-6-7-8-11.			

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.90	7.38		
	Volatile matter ..	40.90	39.42	42.56	46.20
	Fixed carbon .....	47.63	45.90	49.56	53.80
	Ash .....	7.57	7.30	7.88	
		100.00	100.00	100.00	100.00
Sulphur .....		3.82	3.68	3.97	4.31
Calorific Value Determined	Calories .....	7075	6819	7362	7991
	B. T. U. ....	12735	12274	13252	14384

No. 64.

Laboratory number .....	19,238
Operator .....	Norton Coal Mining Co.
Mine (shaft) .....	Nortonville, No. 1
Location .....	1,000 feet west of Nortonville
Location in mine .....	Face of room 22, 2nd east entry, 2,500 feet from shaft.
Coal .....	No. 11
Date of sampling .....	4-20-'14
Date of analysis .....	5-19-'14
Depth below surface .....	40 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
1. Coal .....			7
2. Mother coal .....			1
3. Coal mixed with sulphur.....		3	5
4. "Blue band" .....			1½
5. Coal .....			1
6. Sulphur band .....			¾
7. Coal mixed with sulphur.....		1	9½
Total .....		6	1¾
Floor—soft, smooth fire clay.			
Excluded from sample, Nos. 4-5-6.			

Air-dry Loss, 4.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.03	8.36		
	Volatile matter ..	40.17	38.36	41.86	45.32
	Fixed carbon .....	48.47	46.28	50.50	54.68
	Ash .....	7.33	7.00	7.64	
		100.00	100.00	100.00	100.00
Sulphur		3.46	3.30	3.60	3.90
Calorific Value Determined	Calories	7102	6782	7401	8013
	B. T. U.	12784	12208	13322	14423

No. 65.

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Laboratory number .....19,239
Operator .....Norton Coal Mining Co.
Mine (shaft) .....Nortonville No. 1
Location .....1,000 feet west of Nortonville
Location in mine.....Face of room 23, 2nd west entry,
                        3,000 feet from shaft.
Coal .....No. 11
Date of sampling .....4-20-'14
Date of analysis .....5-22-'14
Depth below surface .....170 feet

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## SECTION OF MINE.

Roof—Limestone		Feet	Inches
1. Coal .....		1	3
2. Sulphur band .....			1
3. Coal .....		1	1
4. Mother coal .....			1
5. Coal streaked with mother and sulphur.....		1	8½
6. "Blue band" .....			2
7. Coal with mother coal and sulphur.....		2	
Total .....		6	4½
Floor—soft, smooth fire clay.			
Excluded from sample, Nos. 2-6.			

Air-dry Loss, 4.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.74	7.59	41.10	44.95
	Volatile matter ..	39.56	37.98	50.34	55.05
	Fixed carbon .....	48.46	46.52	8.56	
	Ash .....	8.24	7.91		
		100.00	100.00	100.00	100.00
Sulphur		4.06	3.90	4.22	4.61
Calorific Value Determined	Calories .....	7008	6728	7280	7961
	B. T. U. ....	12614	12110	13104	14330

## HOPKINS COUNTY.

No. 66.

Laboratory number .....19,240  
 Operator .....Norton Coal Mining Co.  
 Mine (shaft) .....Nortonville No. 1  
 Location .....1,000 feet west of Nortonville  
 Location in mine .....Face of 2nd east entry, air course,  
 3,000 feet east of shaft.  
 Coal .....No. 11  
 Date of sampling .....4-20-'14  
 Date of analysis .....5-19-'14  
 Depth below surface .....40 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4	Inches		
Draw Slate			6		
1.	Coal with streaks of mother coal.....	1	8		
2.	Sulphur and mother coal.....		1½		
3.	Coal .....	2	2		
4.	Sulphur band .....		¾		
5.	Coal .....		4		
6.	"Blue band" .....		1½		
7.	Coal .....	1	3		
8.	Coal high in sulphur.....		7		
Total .....		6	2¾		
Floor—rough, soft fire clay, 2 feet. Excluded from sample, Nos. 4-6-8.					
Air-dry Loss, 4-3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.51	7.67	.....	.....
	Volatile matter ..	40.89	39.13	42.38	45.58
	Fixed carbon .....	48.82	46.71	50.59	54.42
	Ash .....	6.78	6.49	7.03	.....
		100.00	100.00	100.00	100.00
Sulphur		3.56	3.41	3.69	3.97
Calorific Value Determined	Calories .....	7188	6878	7450	8013
	B. T. U. ....	12938	12380	13410	14423

## HOPKINS COUNTY.

No. 67.

Laboratory number .....19,241  
 Operator .....Norton Coal Mining Co.  
 Mine (shaft) .....Nortonville, No. 1  
 Location .....1,000 feet west of Nortonville  
 Location in mine .....Face of room 25, off first west entry,  
 2,500 feet west of shaft.  
 Coal .....No. 11  
 Date of sampling .....4-20-'14  
 Date of analysis .....5-19-'14  
 Depth below surface .....170 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4	Inches
Draw Slate			6
1. Coal .....		1	4
2. Sulphur band .....			$\frac{3}{4}$
3. Coal with irregular bands of mother coal.....		2	1
4. Mother coal .....			1
5. Coal .....			9
6. "Blue band" .....			1 $\frac{1}{2}$
7. Coal .....			1
8. Sulphur band .....			$\frac{1}{2}$
9. Coal with irregular sulphur bands.....		1	7
10. Bottom coal .....			4
Total .....		6	5 $\frac{3}{4}$
Floor—hard fire clay.			
Excluded from sample, Nos. 2-6-7-8-10.			

Air-dry Loss, 3.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.54	7.92	.....	.....
	Volatile matter ..	40.66	39.22	42.59	45.59
	Fixed carbon ...	48.51	46.79	50.82	54.41
	Ash . . . . .	6.29	6.07	6.59	.....
		100.00	100.00	100.00	100.00
Sulphur		3.21	3.10	3.37	3.61
Calorific Value Determined	Calories	7139	6886	7478	8005
	B. T. U. ...	12850	12395	13460	14409

## HOPKINS COUNTY.

No. 68.

Laboratory number ..... 19,242  
 Operator ..... Norton Coal Mining Co.  
 Mine (shaft) ..... Nortonville, No. 1  
 Location ..... 1,000 feet W. of Nortonville  
 Location in mine ..... Face of second west entry,  
 3,000 feet west of shaft.  
 Coal ..... No. 11  
 Date of sampling ..... 4-20-'14  
 Date of analysis ..... 5-22-'14  
 Depth below surface ..... 225 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4	Inches		
1. Coal .....			6½		
2. Sulphur lens .....			½		
3. Coal .....			9½		
4. Sulphur band .....			½		
5. Coal .....		2	9½		
6. "Blue band" .....			1½		
7. Coal .....			1		
8. Sulphur band .....			¾		
9. Coal .....			8½		
10. Sulphur band .....			½		
11. Coal with sulphur band, 5" from top .....		1	2		
Total .....		6	4¾		
Floor—rough, soft fire clay, 1 to 2 feet. Excluded from sample, Nos. 4-6-7-8-10.					
Air-dry Loss 3.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.61	7.83	...	...
	Volatile matter ..	39.99	38.64	41.92	45.16
	Fixed carbon .....	48.56	46.92	50.91	54.34
	Ash .....	6.84	6.61	7.17	...
		100.00	100.00	100.00	100.00
Sulphur		3.60	3.48	3.78	4.07
Calorific Value Determined	Calories .....	7082	6843	7425	7998
	B. T. U. ....	12478	12317	13365	14396

## HOPKINS COUNTY.

No. 69.

Laboratory number ..... 19,243  
 (Composite of 19,237-38-39-40-41-42.)  
 Operator ..... Norton Coal Mining Co.  
 Mine (shaft) ..... Nortonville, No. 1  
 Location ..... 1,000 feet west of Nortonville  
 Coal ..... No. 11  
 Date of analysis ..... 5-22-'14

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.14	7.87		
	Volatile matter	40.46	38.89	42.21	45.67
	Fixed carbon	48.15	46.27	50.22	54.33
	Ash	7.25	6.97	7.57	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen	5.82	5.54	5.07	5.49
	Carbon	71.28	68.51	74.36	80.45
	Nitrogen	1.30	1.25	1.36	1.47
	Oxygen	11.17	14.19	7.80	8.44
	Sulphur	3.68	3.54	3.84	4.15
		7.25	6.97	7.57	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories	7100	6824	7407	8014
	B. T. U.	12780	12283	13333	14425
Calorific Value Calculated From			6914		
Ultimate Analysis			12445		

SECOND ANNUAL REPORT  
HOPKINS COUNTY.

No. 70.

Laboratory number .....19,252  
Operator .....St. Bernard Mining Co.  
Mine (drift) .....Fox Run  
Location .....2 miles N. E. of St. Charles  
Location in mine.....Face of room 40, off 10 east,  
3,500 feet from entrance.  
Coal .....No. 9  
Date of sampling .....4-21-'14  
Date of analysis .....5-13-'14  
Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1.	Coal adhering to roof.....		1
2.	Coal .....		1
3.	Sulphur band .....		$\frac{1}{8}$
4.	Coal .....		$7\frac{1}{4}$
5.	Soft sulphur band .....		$\frac{1}{2}$
6.	Coal streaked with sulphur.....		6
7.	Mother coal .....		$\frac{1}{4}$
8.	Coal mixed with sulphur.....	3	7
Total .....		4	$11\frac{1}{2}$
Floor—fire clay.			
Excluded from sample, No. 1.			

Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.65	8.64		
	Volatile matter .	38.55	37.33	40.86	45.15
	Fixed carbon ...	46.83	45.34	49.63	54.35
	Ash .....	8.97	8.69	9.51	
		100.00	100.00	100.00	100.00
Sulphur		3.30	3.20	3.50	3.87
Calorific Value Determined	Calories .....	6816	6600	7224	7983
	B. T. U. ....	12269	11880	13003	14369

KENTUCKY GEOLOGICAL SURVEY  
HOPKINS COUNTY.

No. 71.

Laboratory number .....19,253  
Operator .....St. Bernard Mining Co.  
Mine (drift) .....Fox Run  
Location .....2 miles N. E. of St. Charles  
Location in mine.....Face of room 11, 12th east,  
3,000 feet from entrance.  
Coal .....No. 9  
Date of sampling .....4-21-'14  
Date of analysis .....5-22-'14

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal adhering to roof.....			1
2. Coal streaked with sulphur.....	1		2½
3. Sulphur band .....			½
4. Coal streaked with mother coal.....			3¾
5. Mother coal .....			¼
6. Coal .....	1		3½
7. Sulphur band .....			1
8. Coal .....	1		11
Total .....		4	11½
Floor—hard fire clay. Excluded from sample, Nos. 1-3-7.			

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.77	8.89		
	Volatile matter ..	39.23	37.93	41.63	45.37
	Fixed carbon .....	47.23	45.67	50.13	54.63
	Ash .....	7.77	7.51	8.24	
		100.00	100.00	100.00	100.00
Sulphur		2.27	2.19	2.40	2.62
Calorific Value Determined	Calories .....	6907	6678	7330	7988
	B. T. U. ....	12433	12020	13194	14378

## HOPKINS COUNTY.

No. 72.

Laboratory number .....19,254  
 Operator .....St. Bernard Mining Co.  
 Mine (drift) .....Fox Run  
 Location .....2 miles N. E. of St. Charles  
 Location in mine.....Face of 9th west entry,  
 3,500 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-21-'14  
 Date of analysis .....5-19-'14

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal .....			5¼
2. Thin sulphur band .....			
3. Coal streaked with sulphur and mother coal....		4	7
Total .....		5	0¼
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.99	9.61	.....	.....
	Volatile matter ..	38.71	37.22	41.18	44.77
	Fixed carbon .....	47.77	45.93	50.81	55.23
	Ash .....	7.53	7.24	8.01	.....
		100.00	100.00	100.00	100.00

Sulphur		2.91	2.80	3.10	3.37
Calorific Value Determined	Calories .....	6942	6675	7385	8028
	B. T. U. ....	12496	12015	13293	14450

## HOPKINS COUNTY.

No. 73.

Laboratory number .....19,255  
 Operator .....St. Bernard Mining Co.  
 Mine (drift) .....Fox Run  
 Location .....2 miles N. E. of St. Charles  
 Location in mine.....Face of 7th west entry,  
 3,500 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-21-'14  
 Date of analysis .....6-1-'14

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal with sulphur streaks.....		1	9
2. Soft sulphur band.....			½
3. Coal streaked with mother coal.....		2	
4. Sulphur band .....			¼
5. Coal .....			10
Total .....		4	7¾
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.59	7.82		
	Volatile matter ..	39.11	37.78	40.98	45.25
	Fixed carbon .....	47.29	45.70	49.58	54.75
	Ash .....	9.01	8.70	9.44	
		100.00	100.00	100.00	100.00

Sulphur		3.91	3.78	4.10	4.53
Calorific Value Determined	Calories .....	6858	6626	7188	7937
	B. T. U. ....	12344	11927	12938	14287

## HOPKINS COUNTY.

No. 74.

Laboratory number .....19,256  
 Operator .....St. Bernard Mining Co.  
 Mine (drift) .....Fox Run  
 Location .....2 miles N. E. of St. Charles  
 Location in mine .....Rib of room 35, off 10th east,  
 3,500 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-21-'14  
 Date of analysis .....5-13-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 2 to 3	Inches
1. Coal with thin sulphur 2" from top.....			7
2. Thin sulphur lens.....			
3. Coal .....			8
4. Sulphurous coal .....			$\frac{3}{4}$
5. Coal .....			6
6. Mother coal .....			$\frac{1}{2}$
7. Coal .....	1		2
8. Sulphur band .....			$\frac{1}{4}$
9. Coal .....			$5\frac{1}{2}$
10. Thin sulphur band .....			
11. Coal .....	1		5
Total .....		4	11
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.40	8.47		
	Volatile matter ..	38.80	37.54	41.01	45.80
	Fixed carbon .....	45.90	44.41	48.52	54.20
	Ash .....	9.90	9.58	10.47	
		100.00	100.00	100.00	100.00
Sulphur		3.67	3.55	3.88	4.33
Calorific Value Determined	Calories .....	6734	6516	7119	7951
	B. T. U. ....	12121	11729	12814	14312

## HOPKINS COUNTY.

No. 75.

Laboratory number .....19,257  
 Operator .....St. Bernard Mining Co.  
 Mine (drift) .....Fox Run  
 Location .....2 miles N. E. of St. Charles  
 Location in mine .....Rib of room 9, off 13th east,  
 3,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-21-'14  
 Date of analysis .....5-13-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 2 to 3	Inches
1. Coal .....		1	3½
2. Sulphur band .....			¾
3. Coal .....		1	2½
4. Coal with spar sulphur.....			2
5. Coal .....		1	3
6. Coal with thin sulphur bands.....			5½
7. Coal .....			4½
Total .....		4	9¼
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.26	8.47	.....	.....
	Volatile matter ..	36.74	34.76	37.98	44.57
	Fixed carbon .....	45.70	43.24	47.24	55.43
	Ash .....	14.30	13.53	14.78	.....
		100.00	100.00	100.00	100.00
Sulphur		2.79	2.64	2.88	3.33
Calorific Value Determined	Calories .....	6568	6214	6789	7966
	B. T. U. ....	11822	11185	12220	14339

SECOND ANNUAL REPORT  
HOPKINS COUNTY.

No. 76.

Laboratory number .....19,258  
Operator ..... St. Bernard Mining Co.  
Mine (drift) ..... Fox Run  
Location ..... 2 miles N. E. of St. Charles  
Location in mine.....Face of 15 east,  
3,000 feet from entrance.  
Coal ..... No. 9  
Date of sampling ..... 4-21-'14  
Date of analysis .. 5-13-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 2 to 3	Inches
1. Coal adhering to roof.....			1
2. Coal .....	1		5
3. Mother coal and sulphur.....			1
4. Coal .....			9½
5. Mother coal .....			½
6. Coal with thin irregular sulphur bands.....	2		5
Total .....	4		10
Floor—hard, smooth fire clay.			
Excluded from sample, No. 1.			

Air-dry Loss, 5.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.51	8.52		
	Volatile matter ..	39.19	37.16	40.62	44.49
	Fixed carbon .....	48.92	46.37	50.69	55.51
	Ash .....	8.38	7.95	8.69	
		100.00	100.00	100.00	100.00
Sulphur		3.40	3.22	3.52	3.86
Calorific Value Determined	Calories .....	7042	6677	7299	7994
	B. T. U. ....	12676	12019	13138	14389

## HOPKINS COUNTY.

No. 77.

Laboratory number .....19,259  
Operator ..... St. Bernard Mining Co.  
Mine (drift) ..... Fox Run  
Location ..... 2 miles N. E. of St. Charles  
Location in mine.....Face of room 2, off 7th west,  
3,000 feet from entrance.  
Coal ..... No. 9  
Date of sampling ..... 4-21-'14  
Date of analysis .. 5-13-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 2 to 3	Inches
1. Coal		1	2½
2. Thin sulphur band			
3. Coal		1	8½
4. Hard sulphur lens			¾
5. Coal		1	
6. Thin sulphur band			
7. Coal			9½
Total		4	9¼
Floor—hard, smooth fire clay.			
Excluded from sample, No. 4.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.34	8.52		
	Volatile matter ..	39.36	37.25	40.72	45.81
	Fixed carbon .....	46.55	44.06	48.16	54.19
	Ash .....	10.75	10.17	11.12	
		100.00	100.00	100.00	100.00
Sulphur		3.91	3.70	4.04	4.55
Calorific Value Determined	Calories .....	6843	6476	7079	7965
	B. T. U. ....	12317	11657	12742	14337

## HOPKINS COUNTY.

No. 78.

Laboratory number .....19,260  
 (Composite of 19252-53-54-55-56-57-58-59.)  
 Operator .....St. Bernard Mining Co.  
 Mine (drift) .....Fox Run  
 Locality .....2 miles N. E. of St. Charles  
 Coal .....No. 9  
 Date of analysis .....5-22-'14

Air-dry Loss, 4.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.69	8.61	.....	.....
	Volatile matter ..	38.61	37.02	40.51	45.13
	Fixed carbon .....	46.94	45.01	49.25	54.87
	Ash .....	9.76	9.36	10.24	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.21	5.46	4.92	5.48
	Carbon .....	68.26	65.45	71.62	79.79
	Nitrogen .....	1.44	1.38	1.51	1.68
	Oxygen .....	12.07	15.22	8.29	9.24
	Sulphur .....	3.26	3.13	3.42	3.81
	Ash .....	9.76	9.36	10.24	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6848	6567	7186	8005
	B. T. U. ....	12326	11821	12935	14409
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6586	.....	.....
	B. T. U. ....	.....	11855	.....	.....

## HOPKINS COUNTY.

No. 79.

Laboratory number .....19,261  
 Operator .....Carbondale Coal and Coke Co.  
 Mine (drift) .....No. 1  
 Location .....2 miles N. W. of St. Charles  
 Location in mine.....Face of 7th west, off 6th north entry,  
 4,500 feet from entrance.

Coal .....No. 9  
 Date of sampling .....4-22-'14  
 Date of analysis .....5-13-'14  
 Depth below surface .....60 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Coal .....		1	5½
2. Sulphur band .....			1½
3. Coal .....			10
4. Coal with streaks of mother coal.....			6
5. Coal .....	1		3
6. Thin sulphur band.....			
7. Coal .....			9
Total .....		4	11
Floor—hard, smooth fire clay.			
Excluded from sample, No. 2.			

Air-dry Loss, 6.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.93	8.85		
	Volatile matter ..	40.17	37.72	41.38	45.08
	Fixed carbon .....	48.95	45.96	50.42	54.92
	Ash .....	7.95	7.47	8.20	
		100.00	100.00	100.00	100.00
Sulphur		2.63	2.47	2.71	2.95
Calorific Value Determined	Calories .....	7110	6676	7324	7978
	B. T. U. ....	12798	12017	13183	14360

## HOPKINS COUNTY.

No. 80.

Laboratory number .....19,262  
 Operator .....Carbondale Coal and Coke Co.  
 Mine (drift) .....No. 1  
 Location .....2 miles N.W. of St. Charles  
 Location in mine.....Face of main 3rd north entry,  
 2,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-22-'14  
 Date of analysis .....5-13-'14  
 Depth below surface ... 60 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Coal .....		1	3
2. Thin sulphur band .....			
3. Coal with irregular mother coal.....		2	9
4. Thin sulphur band .....			
5. Coal .....			7½
Total ..		4	7½
Floor—hard, smooth fire clay, 8 to 10 feet. Excluded from sample, none.			

Air-dry Loss, 6.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.16	9.53		
	Volatile matter ..	39.04	36.47	40.31	44.13
	Fixed carbon .....	49.42	46.17	51.04	55.87
	Ash .....	8.38	7.83	8.65	
		100.00	100.00	100.00	100.00
Sulphur		3.23	3.06	3.38	3.70
Calorific Value Determined	Calories .....	7031	6563	7260	7948
	B. T. U. ....	12656	11822	13068	14306

## HOPKINS COUNTY.

No. 81.

Laboratory number .....19,263  
 Operator .....Carbondale Coal and Coke Co.  
 Mine (drift) .....No. 1  
 Location .....2 miles N. W. of St. Charles  
 Location in mine.....Neck of room 12, off 6th east, off 3rd north,  
 3,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling . ... 4-22-'14  
 Date of analysis .....5-21-'14  
 Depth below surface .....60 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2	Inches
1. Coal .....		1	1
2. Sulphur band .....			2
3. Coal .....		1	6½
4. Mother coal .....			½
5. Coal .....			3
6. Sulphur band .....			1
7. Coal with disseminated sulphur.....		1	5
Total .....		4	7
Floor—hard, smooth fire clay, 8 to 10 feet. Excluded from sample, Nos. 2-6.			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.97	8.21	40.84	45.77
	Volatile matter ..	39.63	37.49	48.40	54.23
	Fixed carbon .....	46.96	44.42	10.76	
	Ash .....	10.44	9.33		
		100.00	100.00	100.00	100.00
Sulphur		3.92	3.71	4.04	4.53
Calorific Value Determined	Calories .....	6819	6451	7028	7876
	B. T. U. ....	12274	11612	12650	14177

## HOPKINS COUNTY.

No. 82.

Laboratory number .....19,264  
 Operator ..... Carbondale Coal and Coke Co.  
 Mine (drift) .....No. 1  
 Location .....2 miles N. W. of St. Charles  
 Location in mine.....Face of 3rd east, off 3rd north,  
 3,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-22-'14  
 Date of analysis .....5-4-'14  
 Depth below surface .....40 feet

## SECTION OF MINE.

Roof—Black Slate		Inches	Feet
1. Coal .....		1	2
2. Mother coal .....			$\frac{1}{8}$
3. Coal with thin sulphur band.....		2	10 $\frac{1}{2}$
4. Mother coal .....			$\frac{1}{4}$
5. Coal .....			5
Total .....		4	5 $\frac{7}{8}$
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 6.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.52	10.05	.....	.....
	Volatile matter .....	39.08	36.43	40.50	43.96
	Fixed carbon .....	49.79	46.43	51.62	56.04
	Ash .....	7.61	7.09	7.88	.....
		100.00	100.00	100.00	100.00

Sulphur		3.41	3.18	3.54	3.84
Calorific Value Determined	Calories .....	7093	6613	7352	7981
	B. T. U. ....	12767	11903	13234	14366

## HOPKINS COUNTY.

No. 83.

Laboratory number .....19,265  
 Operator .....Carbondale Coal and Coke Co.  
 Mine (drift) .....No. 1  
 Location .....2 miles N. W. of St. Charles  
 Location in mine ..... Face of room 22, off third east, off third north,  
 3,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-22-'14  
 Date of analysis .....5-13-'14  
 Depth below surface .....60 feet

## SECTION OF MINE.

Roof—Black Slate			Feet	Inches	
1. Coal .....			1	1	
2. Sulphur band .....				1	
3. Coal mixed with sulphur.....			3	3	
Total .....			4	5	
Floor—hard, smooth fire clay. Excluded from sample, No. 2.					
Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.27	8.52	.....	.....
	Volatile matter ..	39.43	37.29	40.76	44.93
	Fixed carbon ....	48.32	45.70	49.96	55.07
	Ash .....	8.98	8.49	9.28	.....
		100.00	100.00	100.00	100.00
Sulphur		3.86	3.65	3.99	4.40
Calorific Value Determined	Calories .....	7002	6622	7239	7980
	B. T. U. ....	12604	11920	13030	14364

## HOPKINS COUNTY.

No. 84.

Laboratory number . . . . . 19,266  
 Operator . . . . . Carbondale Coal and Coke Co.  
 Mine (drift) . . . . . No. 1  
 Location . . . . . 2 miles N. W. of St. Charles  
 Location in mine . . . . . Face of room 9, off 5th east, off 5th north,  
 5,000 feet from entrance.  
 Coal . . . . . No. 9  
 Date of sampling . . . . . 4-22-14  
 Date of analysis . . . . . 5-13-14  
 Depth below surface . . . . . 60 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal .....		1	.....
2. Mother coal .....			¼
3. Coal .....		1	2½
4. Sulphur band .....			¼
5. Coal streaked with sulphur.....		2	4½
Total .....		4	7½
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.17	8.49	.....	.....
	Volatile matter ..	39.43	37.27	40.73	45.02
	Fixed carbon .....	48.17	45.52	49.74	54.98
	Ash .....	9.23	8.72	9.53	.....
		100.00	100.00	100.00	100.00
Sulphur		3.76	3.55	3.88	4.29
Calorific Value Determined	Calories .....	6967	6585	7196	7954
	B. T. U. ....	12541	11853	12953	14317

## HOPKINS COUNTY.

No. 85.

Laboratory number . . . . . 19,267  
 (Composite of 19261-62-63-64-65-66.)  
 Operator . . . . . Carbondale Coal and Coke Co.  
 Mine (drift) . . . . . No. 1  
 Location . . . . . 2 miles N. W. of St. Charles  
 Coal . . . . . No. 9  
 Date of analysis . . . . . 5-13-14

Air-dry Loss, 6.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.18	8.95		
	Volatile matter	39.37	37.02	40.66	44.73
	Fixed carbon	48.65	45.75	50.25	55.27
	Ash	8.80	8.28	9.09	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen	5.18	5.53	4.99	5.49
	Carbon	70.28	66.09	72.59	79.85
	Nitrogen	1.52	1.43	1.57	1.73
	Oxygen	10.72	15.38	8.15	8.96
	Sulphur	3.50	3.29	3.61	3.97
	Ash	8.80	8.28	9.09	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories	7012	6594	7242	7966
	B. T. U.	12622	11869	13036	14339
Calorific Value Calculated From			6658		
Ultimate Analysis			11984		

## HOPKINS COUNTY.

No. 86.

Laboratory number ..... 19,298  
 Operator ..... J. W. Workman  
 Mine (shaft) ..... Workman  
 Location ..... 1 mile N. of Dawson Springs  
 Location in mine ..... Face of main east entry,  
 500 feet from shaft.  
 Coal ..... Dawson  
 Date of sampling ..... 4-23-'14  
 Date of analysis ..... 5-15-'14  
 Depth below surface ..... 100 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1. Soft coal .....			4½
2. Thin sulphur band .....			
3. Hard coal .....		1	½
4. Sulphur lens .....			¼
5. Hard coal .....		2	7½
Total .....		4	0¾
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	8.55	8.95		
	Volatile matter ..	41.35	39.03	42.87	45.00
	Fixed carbon .....	50.52	47.70	52.39	55.00
	Ash .....	4.58	4.32	4.74	
		100.00	100.00	100.00	100.00

Sulphur		2.88	2.72	2.99	3.14
Calorific Value Determined	Calories .....	7471	7058	7746	8132
	B. T. U. ....	13448	12695	13943	14638

## HOPKINS COUNTY.

No. 87.

Laboratory number ..... 19,299  
 Operator ..... J. W. Workman  
 Mine (shaft) ..... Workman  
 Location ..... 1 mile north of Dawson Springs  
 Location in mine ..... Face of room 3, off main east entry,  
 500 feet from shaft.  
 Coal ..... Dawson  
 Date of sampling ..... 4-23-'14  
 Date of analysis ..... 5-15-'14  
 Depth below surface ..... 100 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1. Coal .....			4
2. Thin sulphur band .....			
3. Soft coal .....		3	7
Total .....		3	11
Floor—hard fire clay. Excluded from sample, none.			

Air-dry Loss, 4.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.23	8.20		
	Volatile matter ..	40.92	39.22	42.72	44.57
	Fixed carbon .....	50.89	48.78	53.14	55.43
	Ash .....	3.96	3.80	4.14	
		100.00	100.00	100.00	100.00

Sulphur		2.35	2.25	2.45	2.56
Calorific Value Determined	Calories .....	7457	7148	7786	8122
	B. T. U. ....	13423	12866	14015	14620

## HOPKINS COUNTY.

No. 88.

Laboratory number .....19,300  
 Operator .....J. W. Workman  
 Mine (shaft) .....Workman  
 Location .....1 mile north of Dawson Springs  
 Location in mine .....Left rib near face of room 2, off air course,  
 500 feet from entrance.  
 Coal ..... Dawson  
 Date of sampling .....4-23-'14  
 Date of analysis .....5-15-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Dark Gray slate		Feet	Inches
1. Shaly coal .....		2	3
2. Mother coal .....			$\frac{1}{4}$
3. Shaly coal .....		1	2
4. Hard coal with some sulphur.....			$9\frac{1}{2}$
Total .....		4	$2\frac{3}{4}$
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 4.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.44	8.99	.....	.....
	Volatile matter ..	38.61	36.77	40.40	43.57
	Fixed carbon .....	50.00	47.62	52.33	56.43
	Ash .....	6.95	6.62	7.27	.....
		100.00	100.00	100.00	100.00
Sulphur		3.86	3.68	4.04	4.36
Calorific Value Determined	Calories .....	7207	6864	7542	8133
	B. T. U. ....	12973	12355	13576	14639

## HOPKINS COUNTY.

No. 89.

Laboratory number .....19,301  
 Operator .....J. W. Workman  
 Mine (shaft) .....Workman  
 Location .....1 mile north of Dawson Springs  
 Location in mine .....Right rib at face of room 2, off air course,  
 500 feet from entrance  
 Coal ..... Dawson  
 Date of sampling .....4-23-'14  
 Date of analysis .....5-21-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Dark Gray Slate		Feet	Inches
1. Coal .....			3
2. Mother coal .....			$\frac{1}{2}$
3. Coal streaked with mother coal.....	2	6	
4. Sulphur band .....			$\frac{1}{2}$
5. Coal .....	1	2	
Total .....		3	11 $\frac{1}{4}$
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 4.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.40	8.76		
	Volatile matter ..	39.60	37.79	41.42	43.98
	Fixed carbon .....	50.45	48.15	52.77	56.02
	Ash .....	5.55	5.30	5.81	
		100.00	100.00	100.00	100.00
Sulphur		2.84	2.71	2.97	3.16
Calorific Value Determined	Calories ..	7292	6959	7627	8098
	B. T. U. ....	13126	12526	13729	14576

## HOPKINS COUNTY.

No. 90.

Laboratory number .....19,302F  
 (Composite of 19,298-99-300-01.)  
 Operator .....J. W. Workman  
 Mine .....Workman  
 Location .....1 mile north of Dawson Springs  
 Coal .....Dawson  
 Date of analysis .....5-15-'14

Air-dry Loss, 4.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.27	8.84	.....	.....
	Volatile matter ..	39.73	37.83	41.50	43.93
	Fixed carbon .....	50.70	48.28	52.96	56.07
	Ash .....	5.30	5.05	5.54	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.47	5.74	5.22	5.53
	Carbon .....	73.86	70.34	77.16	81.68
	Nitrogen .....	1.71	1.63	1.79	1.89
	Oxygen .....	10.74	14.46	7.24	7.67
	Sulphur .....	2.92	2.78	3.05	3.23
	Ash .....	5.30	5.05	5.54	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7332	6982	7659	8108
	B. T. U. ....	13198	12568	13786	14594
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	7100	.....	.....
	B. T. U. ....	.....	12780	.....	.....

## McLEAN COUNTY.

No. 91.

Laboratory number .....19,281  
 Operator .....O'Neill Coal Company  
 Mine (shaft) .....O'Neill  
 Location .....1,000 feet N. of Island Station  
 Location in mine.....Face of room 4, third south entry,  
 600 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-27-'14  
 Date of analysis .....5-14-'14  
 Depth below surface .....85 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal (bone) .....			1½
2. Coal .....		1	3
3. Sulphur band .....			2
4. Coal mixed with sulphur.....			8
5. Mother coal .....			¾
6. Coal streaked with sulphur and mother coal. .	1		7¾
7. Soft sulphur band .....			½
8. Coal .....			4
Total .....		4	3
Floor—hard, smooth fire clay. Excluded from sample, No. .3			

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.23	9.36	.....	.....
	Volatile matter ..	39.42	37.31	41.16	46.24
	Fixed carbon .....	45.83	43.37	47.85	53.76
	Ash .....	10.52	9.96	10.99	.....
		100.00	100.00	100.00	100.00
Sulphur		3.64	3.44	3.80	4.27
Calorific Value Determined	Calories .. ..	6832	6466	7134	8015
	B. T. U. ....	12298	11639	12841	14427

## McLEAN COUNTY.

No. 92.

Laboratory number .....19,282  
 Operator ..... O'Neil Coal Company  
 Mine (shaft) ..... O'Neil  
 Location ..... 1,000 feet N. of Island Station  
 Location in mine ..... Face of main west entry,  
 750 feet from bottom of shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-27-'14  
 Date of analysis ..... 5-14-'14  
 Depth below surface ..... 75 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal ..			5½
2. Thin sulphur band ..			
3. Coal ..			7½
4. Mother coal ..			¾
5. Coal ..			7½
6. Mother coal ..			½
7. Coal ..			2
8. Mother coal ..			½
9. Coal streaked with mother coal ..		2	3
Total ..		4	3¼
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 6.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.61	9.62		
	Volatile matter ..	41.74	39.14	43.30	47.72
	Fixed carbon .....	45.72	42.87	47.44	52.28
	Ash .....	8.93	8.37	9.26	
		100.00	100.00	100.00	100.00
Sulphur		2.89	2.71	3.00	3.31
Calorific Value Determined	Calories .....	7020	6582	7282	8025
	B. T. U. ....	12636	11848	13108	14445

## McLEAN COUNTY.

No. 93.

Laboratory number .....19,283  
 Operator ..... O'Neil Coal Company  
 Mine (shaft) ..... O'Neil  
 Location ..... 1,000 feet N. of Island Station  
 Location in mine ..... Face of ropm 6, off second south entry,  
 400 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-27-'14  
 Date of analysis ..... 5-14-'14  
 Depth below surface ..... 80 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6		
Coal with thin mother coal near center		4	3½		
Total		4	3½		
Floor—hard, smooth fire clay. Excluded from sample, none.					
Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.38	9.26	.....	.....
	Volatile matter ..	40.52	38.45	42.37	47.12
	Fixed carbon .....	45.46	43.14	47.55	52.88
	Ash .....	9.64	9.15	10.08	.....
		100.00	100.00	100.00	100.00
Sulphur		2.87	2.72	3.00	3.34
Calorific Value Determined	Calories .....	6897	6545	7213	8022
	B. T. U. ....	12415	11781	12983	14440

## McLEAN COUNTY.

No. 94.

Laboratory number .....19,284  
 Operator .....O'Neil Coal Company  
 Mine (shaft) .....O'Neil  
 Location .....1,000 feet N. of Island Station  
 Location in mine.....Face of room 9, off first south entry  
                                     400 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-27-'14  
 Date of analysis .....5-14-'14  
 Depth below surface .....80 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal adhering to roof.....			½
2. Coal .....	1	1	
3. Mother coal .....			½
4. Coal with spar sulphur.....			9%
5. Thin sulphur band .....			
6. Coal .....	1	½	
7. Thin sulphur band .....			
8. Coal .....	1	½	
Total .....	4	0%	
Floor—hard, smooth fire clay. Excluded from sample, No. 1.			

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture . . . . .	4.08	8.58		
	Volatile matter ..	40.02	38.14	41.72	47.49
	Fixed carbon .....	44.24	42.17	46.13	52.51
	Ash .....	11.66	11.11	12.15	
		100.00	100.00	100.00	100.00
Sulphur		3.93	3.75	4.10	4.67
Calorific Value Determined	Calories .....	6782	6464	7071	8049
	B. T. U. ....	12208	11635	12728	14488

## McLEAN COUNTY.

No. 95.

Laboratory number .....19,285F  
 (Composite of 19,281-82-83-84.)  
 Operator .....O'Neil Coal Company  
 Mine (shaft) .....O'Neil  
 Location .....1,000 feet N. from Island Station  
 Coal .....No. 9  
 Date of analysis .....5-14-'14

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.12	9.25		
	Volatile matter ..	40.18	38.03	41.91	46.93
	Fixed carbon .....	45.44	43.01	47.39	53.07
	Ash .....	10.26	9.71	10.70	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen ..	5.29	5.60	5.04	5.64
	Carbon .....	68.69	65.02	71.65	80.23
	Nitrogen .....	1.42	1.34	1.48	1.66
	Oxygen .....	11.02	15.19	7.67	8.60
	Sulphur ..	3.32	3.14	3.46	3.87
	Ash .....	10.26	9.71	10.70	
		100.00	100.00	100.00	100.00
Calorific Value Determined		6890	6521	7185	8046
Calories .....		12402	11738	12933	14483
Calorific Value Calculated From Ultimate Analysis			6599		
Calories .....			11878		

## MUHLENBERG COUNTY.

No. 96.

Laboratory number .....13,257  
 Operator .....Central Coal and Iron Co.  
 Mine .....Central  
 Location ..... $\frac{1}{4}$  mile S. of Central City  
 Location in mine.....Face main south entry  
 Coal .....No. 9  
 Date of sampling .....1-23-'12  
 Date of analysis .....2-3-'12

Air-dry Loss, 5.00		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.27	8.11	.....	.....
	Volatile matter ..	40.25	38.24	41.62	44.86
	Fixed carbon .....	49.49	47.01	51.15	55.14
	Ash .....	6.99	6.64	7.23	.....
		100.00	100.00	100.00	100.00
Sulphur		2.53	2.40	2.61	2.81

## MUHLENBERG COUNTY.

No. 97.

Laboratory number .....13,258  
 Operator .....Central Coal and Iron Co.  
 Mine .....Central  
 Location ..... $\frac{1}{4}$  mile S. of Central City  
 Location in mine.....Room 20, main south blind, face of room  
 Coal .....No. 9  
 Date of sampling .....1-22-'12  
 Date of analysis .....2-3-'12

Air-dry Loss, 7.40		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.16	10.33	.....	.....
	Volatile matter ..	38.72	35.85	39.98	44.54
	Fixed carbon .....	48.22	44.65	49.79	55.46
	Ash .....	9.90	9.17	10.23	.....
		100.00	100.00	100.00	100.00
Sulphur		3.19	2.95	3.29	3.67

## MUHLENBERG COUNTY.

No. 98.

Laboratory number .....13,259  
 Operator .....Central Coal and Iron Co.  
 Mine .....Central  
 Location ..... $\frac{1}{4}$  mile S. of Central City  
 Location in mine. ....Room 3, 6th south, off main 20  
 Coal .....No. 9  
 Date of sampling .....1-22-'12  
 Date of analysis .....2-3-'12

Air-dry Loss, 5.10		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.03	7.98	.....	.....
	Volatile matter ..	39.81	37.78	41.06	44.41
	Fixed carbon .....	49.84	47.29	51.39	55.59
	Ash .....	7.32	6.95	7.55	.....
		100.00	100.00	100.00	100.00
Sulphur .....		2.63	2.50	2.72	2.94

## MUHLENBERG COUNTY.

No. 99.

Laboratory number .....13,260F  
 (Composite of 13,257-58-59.)  
 Operator .....Central Coal and Iron Co.  
 Mine .....Central  
 Location ..... $\frac{1}{4}$  mile S. of Central City  
 Coal .....No. 9  
 Date of analysis .....2-14-'12

Air-dry Loss, 5.80		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.11	8.73	.....	.....
	Volatile matter ..	40.09	37.76	41.37	45.11
	Fixed carbon .....	48.75	45.93	50.33	54.89
	Ash .....	8.05	7.58	8.30	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.18	5.52	4.98	5.43
	Carbon .....	71.81	67.65	74.12	80.83
	Nitrogen .....	1.51	1.42	1.56	1.70
	Oxygen .....	10.64	15.18	8.14	8.88
	Sulphur .....	2.81	2.65	2.90	3.16
	Ash .....	8.05	7.58	8.30	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7200	6782	7430	8102
	B. T. U. ....	12960	12208	13374	14584
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6773	.....	.....
	B. T. U. ....	.....	12191	.....	.....

## MUHLENBERG COUNTY.

No. 100.

Laboratory number ..... 15,339  
 Operator ..... Bevier Coal Co.  
 Mine (shaft) ..... Bevier  
 Location ..... Cleaton  
 Location in mine ..... Room 15, off 8th N. air course,  
 4,100 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 12-23-'12  
 Date of analysis ..... 1-22-'13

Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.04	7.98	.....	.....
	Volatile matter ..	39.82	37.79	41.07	45.25
	Fixed carbon ..	48.18	45.73	49.69	54.75
	Ash .....	8.96	8.50	9.24	.....
		100.00	100.00	100.00	100.00
Sulphur		2.90	2.75	2.99	3.29
Calorific Value Determined	Calories .....	7048	6689	7269	8009
	B. T. U. ....	12686	12040	13084	14416

## MUHLENBERG COUNTY.

No. 101.

Laboratory number ..... 15,340  
 Operator ..... Bevier Coal Co.  
 Mine (shaft) ..... Bevier  
 Location ..... Cleaton  
 Location in mine ..... Face of room 21, off 7th north,  
 3,800 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 12-23-'12  
 Date of analysis ..... 1-9-'13

Air-dry Loss, 5.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.10	8.33	.....	.....
	Volatile matter ..	40.14	37.57	41.42	46.02
	Fixed carbon ..	47.07	44.53	48.58	53.98
	Ash .....	9.69	9.17	10.00	.....
		100.00	100.00	100.00	100.00
Sulphur		3.58	3.39	3.70	4.11
Calorific Value Determined	Calories .....	6955	6579	7177	7974
	B. T. U. ....	12519	11842	12919	14353

## MUHLENBERG COUNTY.

No. 102.

Laboratory number ..... 15,341  
 Operator ..... Bevier Coal Company  
 Mine (shaft) ..... Bevier  
 Location ..... Cleaton  
 Location in mine ..... Face of No. 8 south entry,  
 4,500 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 12-23-'12  
 Date of analysis ..... 1-9-'13

Air-dry Loss, 5.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.87	8.21	.....	.....
	Volatile matter ..	38.14	36.04	39.26	44.40
	Fixed carbon .....	47.75	45.18	49.17	55.60
	Ash .....	11.24	10.62	11.57	.....
		100.00	100.00	100.00	100.00
Sulphur		3.99	3.77	4.11	4.65
Calorific Value Determined	Calories .....	6843	6467	7045	7966
	B. T. U. ....	12317	11641	12681	14339

## MUHLENBERG COUNTY.

No. 103.

Laboratory number ..... 16,674  
 Operator ..... Duncan Coal Co.  
 Mine ..... Skibo  
 Location ..... Graham  
 Location in mine ..... Face of 2nd west, off 1st north  
 Coal ..... No. 9  
 Date of sampling ..... 3-5-'13  
 Date of analysis ..... 6-28-'13

		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.65	8.81	.....	.....
	Volatile matter ..	38.20	36.15	39.64	43.77
	Fixed carbon .....	49.05	46.43	50.92	56.23
	Ash .....	9.10	8.61	9.44	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	4.98	5.31	4.76	5.26
	Carbon .....	69.04	65.34	71.65	79.12
	Nitrogen .....	1.55	1.47	1.61	1.78
	Oxygen .....	11.58	15.72	8.65	9.54
	Sulphur .....	3.75	3.55	3.89	4.30
	Ash .....	9.10	8.61	9.44	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6986	6612	7251	8007
	B. T. U. ....	12575	11902	13052	14413
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6510	.....	.....
	B. T. U. ....	.....	11718	.....	.....

## MUHLENBERG COUNTY.

No. 104.

Laboratory number .....16,675  
 Operator .....Duncan Coal Co.  
 Mine .....Skibo  
 Location .....Graham  
 Location in mine .....Face of room 2, off east entry  
 Coal .....No. 9  
 Date of sampling .....3-5-'13  
 Date of analysis .....6-22-'13

		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.28	8.21	.....	.....
	Volatile matter ..	38.35	36.39	39.64	44.52
	Fixed carbon .....	47.77	45.34	49.40	55.48
	Ash .....	10.60	10.06	10.96	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.05	5.36	4.85	5.45
	Carbon .....	68.72	65.22	71.05	79.80
	Nitrogen .....	1.63	1.55	1.69	1.90
	Oxygen .....	10.49	14.48	7.82	8.77
	Sulphur .....	3.51	3.33	3.63	4.08
	Ash .....	10.60	10.06	10.96	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6895	6543	7128	8005
	B. T. U. ....	12411	11777	12830	14409
Calorific Value Calculated From Ultimate Analysis			6568	.....	.....
			11822	.....	.....

## MUHLENBERG COUNTY.

No. 105.

Laboratory number .....19,331  
 Operator .....Lam Coal Company  
 Mine (drift) .....Lam  
 Location .....Bevier  
 Location in mine .....Rib of room 21, off 2nd west, off 1st south,  
 4,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-28-'14  
 Date of analysis .....5-19-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 2
1. Coal .....			1
2. Sulphur band .....			1/2
3. Coal .....			10
4. Thin sulphur band .....			
5. Coal, soft .....			10
6. Coal with spar sulphur .....			4
7. Coal, soft .....		1	9 1/2
8. Thin sulphur band .....			
9. Harder coal .....			11 1/2
Total .....		4	10 1/2
Floor—hard, smooth fire clay.			
Excluded from sample, No. 2.			

Air-dry Loss, 3.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.13	8.76		
	Volatile matter ..	38.37	37.38	40.97	45.84
	Fixed carbon .....	45.92	44.17	48.41	54.16
	Ash .....	10.08	9.69	10.62	
		100.00	100.00	100.00	100.00
Sulphur		4.52	4.35	4.77	5.34
Calorific Value Determined	Calories .....	6799	6539	7167	8018
	B. T. U. ....	12238	11770	12901	14432

SECOND ANNUAL REPORT  
MUHLENBERG COUNTY.

No. 106.

Laboratory number .....19,332  
Operator .....Lam Coal Company  
Mine (drift) .....Lam  
Location .....Bevier  
Location in mine.....Face of 3rd east blind,  
4,500 feet from entrance.  
Coal .....No. 9  
Date of sampling .....4-28-'14  
Date of analysis .....5-19-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Extra hard coal.....		1	3
2. Sulphur band .....			1
3. Very hard coal.....			2½
4. Mother coal .....			¼
5. Very hard coal .....	2		11½
6. Sulphur band .....			¾
7. Very hard coal .....			6
Total .....		5	1
Floor—hard, smooth fire clay. Excluded from sample, Nos. 2 and 6.			

Air-dry Loss, 4.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.28	8.15		
	Volatile matter ..	38.37	36.82	40.09	44.73
	Fixed carbon .....	47.42	45.50	49.53	55.27
	Ash .....	9.93	9.53	10.38	
		100.00	100.00	100.00	100.00
Sulphur		3.83	3.68	4.01	4.47
Calorific Value Determined	Calories .....	6864	6587	7171	8001
	B. T. U. ....	12355	11857	12908	14402

## MUHLENBERG COUNTY.

No. 107.

Laboratory number .....19,333  
Operator .....Lam Coal Company  
Mine (drift) .....Lam  
Location .....Bevier  
Location in mine.....Rib of room 22, off 4th east, off 1st south,  
4,000 feet from entrance.  
Coal .....No. 9  
Date of sampling .....4-28-'14  
Date of analysis .....5-20-'14  
Depth below surface .....150 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal .....		2	3½
2. Mother coal .....			¼
3. Coal .....		3	1
Total .....		5	4¾
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.08	9.13		
	Volatile matter ..	39.62	37.53	41.30	45.43
	Fixed carbon .....	47.57	45.07	49.60	54.57
	Ash .....	8.73	8.27	9.10	
		100.00	100.00	100.00	100.00
Sulphur		3.23	3.06	3.37	3.71
Calorific Value Determined	Calories .....	6991	6623	7289	8019
	B. T. U. ....	12584	11921	13120	14434

SECOND ANNUAL REPORT  
MUHLENBERG COUNTY.

No. 108.

Laboratory number ..... 19,334  
Operator ..... Lam Coal Company  
Mine (drift) ..... Lam  
Location ..... Bevier  
Location in mine ..... Last break-through,  
face of 3rd west, off 1st south, off 2nd west  
2,500 feet from entrance.  
Coal ..... No. 9  
Date of sampling ..... 4-28-'14  
Date of analysis ..... 5-20-'14  
Depth below surface ..... 75 feet

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal			½
2. Thin sulphur band			
3. Coal		1	
4. Mother coal			½
5. Coal streaked with mother and sulphur		3	7¼
6. Mother coal			½
7. Coal			2¼
Total		4	11
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 4.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.58	9.02		
	Volatile matter	39.32	37.49	41.21	45.00
	Fixed carbon	48.07	45.83	50.37	55.00
	Ash	8.03	7.66	8.42	
		100.00	100.00	100.00	100.00
Sulphur		3.46	3.29	3.62	3.95
Calorific Value Determined	Calories	7010	6684	7346	8021
	B. T. U.	12618	12031	13223	14438

KENTUCKY GEOLOGICAL SURVEY  
MUHLENBERG COUNTY.

No. 109.

Laboratory number ..... 19,335  
Operator ..... Lam Coal Company  
Mine (drift) ..... Lam  
Location ..... Bevier  
Location in mine ..... Face of 2nd south entry, off 4th east,  
3,500 feet from entrance.  
Coal ..... No. 9  
Date of sampling ..... 4-28-'14  
Date of analysis ..... 5-25-'14  
Depth below surface ..... 150 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal			3½
2. Sulphur band			½
3. Coal			1½
4. Sulphur ball mixed with coal			2½
5. Coal			2
6. Sulphur band			½
7. Coal		1	1¾
8. Mother coal			½
9. Coal mixed with sulphur		2	11
Total		4	11¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 4 and 6.			

Air-dry Loss, 5.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.13	8.93		
	Volatile matter	40.12	38.11	41.85	46.34
	Fixed carbon	46.45	44.13	48.45	53.66
	Ash	9.30	8.83	9.70	
		100.00	100.00	100.00	100.00
Sulphur		3.71	3.52	3.87	4.29
Calorific Value Determined	Calories	6917	6570	7215	7990
	B. T. U.	12461	11826	12987	14382

## MUHLENBERG COUNTY.

No. 110.

Laboratory number .....19,336  
 Operator .....Lam Coal Company  
 Mine (drift) .....Lam  
 Location .....Bevier  
 Location in mine.....Break-through opposite room 61, 2nd E. entry,  
 3,500 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-28-'14  
 Date of analysis .....5-23-'14  
 Depth below surface .....150 feet

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal .....			4
2. Coal .....			7
3. Mother coal .....			$\frac{1}{4}$
4. Coal .....	1		5 $\frac{1}{2}$
5. Mother coal .....			$\frac{1}{4}$
6. Coal .....			11 $\frac{1}{2}$
7. Mother coal .....			$\frac{1}{4}$
8. Coal streaked with sulphur.....	2		
9. Mother coal and sulphur band.....			$\frac{1}{2}$
10. Coal .....			3
Total .....		5	8 $\frac{1}{4}$
Floor—hard, smooth fire clay.			
Excluded from sample, No. 1.			

Air-dry Loss, 4.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.93	9.58		
	Volatile matter ..	38.07	36.21	40.04	44.50
	Fixed carbon .....	47.47	45.15	49.94	55.50
	Ash .....	9.53	9.06	10.02	
		100.00	100.00	100.00	100.00
Sulphur		3.43	3.26	3.61	4.01
Calorific Value Determined	Calories .....	6871	6535	7227	8032
	B. T. U. ....	12368	11763	13009	14458

## MUHLENBERG COUNTY.

No. 111.

Laboratory number .....19,337  
 (Composite of 19,331-32-33-34-35-36.)  
 Operator .....Lam Coal Company  
 Mine (drift) .....Lam  
 Location .....Bevier  
 Coal .....No. 9  
 Date of analysis .....5-20-'14

Air-dry Loss, 4.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.40	8.82		
	Volatile matter ..	39.10	37.29	40.90	45.27
	Fixed carbon ....	47.27	45.09	49.45	54.73
	Ash .....	9.23	8.80	9.65	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.25	5.52	4.98	5.51
	Carbon .....	69.28	66.08	72.47	80.21
	Nitrogen .....	1.49	1.42	1.56	1.73
	Oxygen ..	11.06	14.66	7.48	8.28
	Sulphur ..	3.69	3.52	3.86	4.27
	Ash ...	9.23	8.80	9.65	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6914	6595	7233	8005
	B. T. U. ....	12445	11871	13019	14409
Calorific Value Calculated From Ultimate Analysis			6690		
	Calories ..		12042		
	B. T. U. ....				

## OHIO COUNTY.

No. 112.

Laboratory number ..... 3,722  
 Operator ..... Broadway Coal Mining Co.  
 Mine (shaft) ..... Broadway  
 Location ..... McHenry  
 Location in mine ..... Room 4, off first west entry,  
 200 feet west of shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 9-6-'09

## SECTION OF MINE.

Roof—Shale		Feet	Inches
1. Coal		1	8
2. Bone coal			1
3. Coal			6
4. Mother coal			$\frac{1}{4}$
5. Coal			4
6. Sulphur			$\frac{1}{8}$
7. Coal		1	4
8. Mother coal			$\frac{1}{2}$
9. Coal			6
Total		4	$5\frac{3}{4}$
Floor—fire clay. Excluded from sample, No. 6.			
Air-dry Loss, 3.3		Coal	
Proximate Analysis	Moisture	10.03	
	Volatile matter	36.06	
	Fixed carbon	46.24	
	Ash	7.67	
		100.00	
Sulphur		2.56	
Calorific Value Determined	Calories	6709	
	B. T. U.	12076	

## OHIO COUNTY.

No. 113.

Laboratory number ..... 3,723  
 Operator ..... Broadway Coal Mining Co.  
 Mine (shaft) ..... Broadway  
 Location ..... McHenry  
 Location in mine ..... North main entry,  
 550 feet north of shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 9-6-'09

## SECTION OF MINE.

Roof—Shale		Feet	Inches
1. Coal		1	2
2. Sulphur			$1\frac{1}{2}$
3. Coal		1	1
4. Mother coal			$\frac{1}{2}$
5. Coal			$5\frac{1}{2}$
6. Sulphur			$\frac{1}{8}$
7. Coal		1	2
8. Sulphur			$\frac{1}{8}$
9. Coal			5
Total		4	$5\frac{3}{4}$
Floor—fire clay. Excluded from sample, No. 2.			
Air-dry Loss, 2.9		Coal	
Proximate Analysis	Moisture	9.89	
	Volatile matter	35.70	
	Fixed carbon	45.72	
	Ash	8.69	
		100.00	
Sulphur		2.45	
Calorific Value Determined	Calories	6626	
	B. T. U.	11927	

## OHIO COUNTY.

No. 114.

Laboratory number .....15,102  
 Operator .....Central Coal and Iron Co.  
 Mine (slope) .....McHenry  
 Location .....McHenry  
 Location in mine.....Room 4, off 3rd south,  
 9,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....11-13-'12  
 Date of analysis .....12-23-'12

Air-dry Loss, 7.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.11	9.89	.....	.....
	Volatile matter ..	38.64	35.94	39.89	45.33
	Fixed carbon .....	46.63	43.36	48.11	54.67
	Ash .....	11.62	10.81	12.00	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	4.94	5.37	4.74	5.39
	Carbon .....	66.96	62.27	69.11	78.54
	Nitrogen .....	1.43	1.33	1.48	1.68
	Oxygen .....	11.14	16.58	8.63	9.80
	Sulphur .....	3.91	3.64	4.04	4.59
	Ash .....	11.62	10.81	12.00	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6805	6329	7024	7982
	B. T. U. ....	12249	11392	12643	14368
Calorific Value Calculated From Ultimate Analysis			6250	.....	.....
B. T. U. ....			11250	.....	.....

## OHIO COUNTY.

No. 115.

Laboratory number .....15,103  
 Operator .....Central Coal and Iron Co.  
 Mine (slope) .....McHenry  
 Location .....McHenry  
 Location in mine.....Room 1, off 4th north,  
 8,500 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....11-13-'12  
 Date of analysis .....12-13-'12

Air-dry Loss, 7.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.19	9.97	.....	.....
	Volatile matter ..	39.29	36.54	40.58	44.84
	Fixed carbon .....	48.32	44.93	49.91	55.16
	Ash .....	9.20	8.56	9.51	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.06	5.49	4.86	5.37
	Carbon .....	69.90	65.01	72.21	79.80
	Nitrogen .....	1.50	1.40	1.55	1.71
	Oxygen .....	11.52	16.92	8.96	9.90
	Sulphur .....	2.82	2.62	2.91	3.22
	Ash .....	9.20	8.56	9.51	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7032	6540	7264	8027
	B. T. U. ....	12658	11772	13075	14449
Calorific Value Calculated From Ultimate Analysis			6473	.....	.....
B. T. U. ....			11651	.....	.....

## OHIO COUNTY.

No. 116.

Laboratory number ..... 19,338  
 Operator ..... Rockport Coal Company  
 Mine (shaft) ..... Crown  
 Location ..... ¼ mile N. W. from Rockport  
 Location in mine ..... Face of room 11, off 6th north, off main east,  
 1,600 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-29-'14  
 Date of analysis ..... 5-27-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches 6
1. Coal .....		1	8
2. Coal with disseminated sulphur .....			4
3. Coal .....		1	4½
4. Thin sulphur band .....			
5. Coal .....		1	0½
Total .....		4	5
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 5.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.78	9.65		
	Volatile matter ..	37.80	35.87	39.70	44.23
	Fixed carbon .....	47.67	45.23	50.06	55.77
	Ash .....	9.75	9.25	10.24	
		100.00	100.00	100.00	100.00
Sulphur		3.42	3.25	3.60	4.01
Calorific Value Determined	Calories .....	6854	6504	7199	8020
	B. T. U. ....	12337	11707	12958	14436

## OHIO COUNTY.

No. 117.

Laboratory number ..... 19,339  
 Operator ..... Rockport Coal Company  
 Mine (shaft) ..... Crown  
 Location ..... ¼ mile N. W. from Rockport  
 Location in mine ..... Face of main east blind,  
 1,800 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-29-'14  
 Date of analysis ..... 5-21-'14  
 Depth below surface ..... 225 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal		1	8
2. Coal containing sulphur			4
3. Coal		1	2
4. Sulphur band			
5. Coal			7
6. Thin sulphur			
7. Coal			8½
Total		4	5½
Floor—hard, smooth, fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	5.20	10.23		
	Volatile matter	37.60	35.60	39.66	44.33
	Fixed carbon	47.22	44.72	49.81	55.67
	Ash	9.98	9.45	10.53	
		100.00	100.00	100.00	100.00
Sulphur		2.84	2.69	3.00	3.35
Calorific Value Determined	Calories	6764	6405	7135	7975
	B. T. U.	12175	11529	12843	14355

Laboratory number .....	19,340
Operator .....	Rockport Coal Company
Mine (shaft) .....	Crown
Location .....	¼ mile N. W. from Rockport
Location in mine.....	Face of 7th south, 2,000 feet from shaft.
Coal .....	No. 9
Date of sampling .....	4-29-'14
Date of analysis .....	5-21-'14
Depth below surface .....	200 feet

### SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal streaked with sulphur.....		1	11
2. Mother coal .....			$\frac{1}{4}$
3. Coal .....			2
4. Mother coal .....			$\frac{1}{2}$
5. Coal mixed with disseminated sulphur.....		2	$2\frac{1}{4}$
6. Mother coal .....			$\frac{1}{2}$
7. Coal .....			$4\frac{1}{2}$
Total .....		4	9
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 4.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.23	9.26		
	Volatile matter ..	37.27	35.69	39.33	44.90
	Fixed carbon .....	45.75	43.80	48.27	55.10
	Ash .....	11.75	11.25	12.40	
		100.00	100.00	100.00	100.00
Sulphur		3.93	3.76	4.14	4.73
Calorific Value Determined	Calories .....	6620	6339	6986	7975
	B. T. U. ....	11916	11410	12575	14355

Laboratory number .....	19,341
Operator .....	Rockport Coal Company
Mine (shaft) .....	Crown
Location .....	1/4 mile N. W. from Rockport
Location in mine .....	Room 19, off 5th south, 15 feet from entry, 1,800 feet from shaft.
Coal .....	No. 9
Date of sampling .....	4-29-'14
Date of analysis .....	5-21-'14
Depth below surface .....	200 feet

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal			4½
2. Mother coal			½
3. Coal			6½
4. Mother coal			¾
5. Coal		1	2½
6. Mother coal			½
7. Coal streaked with mother coal			11½
8. Sulphur band			¾
9. Coal streaked with sulphur			7½
10. Soft sulphur band			¾
11. Coal			6½
Total		4	4½
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.83	9.85		
	Volatile matter	37.22	35.26	39.11	44.16
	Fixed carbon	47.07	44.58	49.45	55.84
	Ash	10.88	10.31	11.44	...
		100.00	100.00	100.00	100.00
Sulphur		3.99	3.78	4.19	4.73
Calorific Value Determined	Calories	6745	6390	7088	8004
	B. T. U.	12141	11502	12758	14407

## OHIO COUNTY.

No. 120.

Laboratory number ..... 19,342  
 Operator ..... Rockport Coal Company  
 Mine (shaft) ..... Crown  
 Location .....  $\frac{1}{4}$  mile N. W. from Rockport  
 Location in mine ..... Neck of room 46, off 3rd south,  
 2,200 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-30-'14  
 Date of analysis ..... 5-27-'14  
 Depth below surface ..... 150 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches
1. Coal		1	3
2. Coal with disseminated sulphur			3
3. Coal			8
4. Mother coal			$\frac{1}{2}$
5. Coal			10
6. Thin sulphur band			
7. Coal			2
8. Thin sulphur band			
9. Coal		1	3
Total		4	5 $\frac{1}{2}$
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 4.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	5.24	9.02		
	Volatile matter	38.06	36.54	40.16	44.23
	Fixed carbon	47.97	46.06	50.63	55.77
	Ash	8.73	8.38	9.21	
		100.00	100.00	100.00	100.00
Sulphur		3.07	2.95	3.24	3.57
Calorific Value Determined	Calories	6905	6629	7286	8025
	B. T. U.	12429	11932	13115	14445

## OHIO COUNTY.

No. 121.

Laboratory number ..... 19,343  
 Operator ..... Rockport Coal Company  
 Mine (shaft) ..... Crown  
 Location .....  $\frac{1}{4}$  mile N. W. of Rockport  
 Location in mine ..... Intersection of 1st east and 4th north,  
 1,200 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-30-'14  
 Date of analysis ..... 5-21-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof—Hard, Black Slate		Feet	Inches
1. Coal		1	3½
2. Sulphur and coal			3
3. Coal			8
4. Mother coal			¼
5. Coal		1	1
6. Sulphur band			⅛
7. Coal with sulphur streaks			6
8. Sulphur band			⅛
9. Coal with sulphur streaks			10¼
Total		4	8¼
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash. Free
Proximate Analysis	Moisture	5.63	9.05		
	Volatile matter	36.97	35.63	39.18	44.79
	Fixed carbon	45.57	43.92	48.29	55.21
	Ash	11.83	11.40	12.53	
		100.00	100.00	100.00	100.00
Sulphur		4.20	4.05	4.45	5.09
Calorific Value Determined	Calories	6582	6344	6975	7974
	B. T. U.	11848	11419	12555	14353

## OHIO COUNTY.

No. 122.

Laboratory number ..... 19,344F  
 (Composite of 19,338-39-40-41-42-43.)  
 Operator ..... Rockport Coal Company  
 Mine (shaft) ..... Crown  
 Location ..... ¼ mile N. W. from Rockport  
 Coal ..... No. 9  
 Date of analysis ..... 5-27-'14

Air-dry Loss, 4.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.13	9.48	.....	.....
	Volatile matter ..	37.37	35.65	39.38	44.24
	Fixed carbon .....	47.07	44.92	49.63	55.76
	Ash .....	10.43	9.95	10.99	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.20	5.47	4.88	5.48
	Carbon .....	67.83	64.72	71.50	80.33
	Nitrogen .....	1.49	1.42	1.57	1.76
	Oxygen .....	11.48	15.03	7.29	8.19
	Sulphur .....	3.57	3.41	3.77	4.24
	Ash .....	10.43	9.95	10.99	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6715	6407	7078	7952
	B. T. U. ....	12087	11533	12740	14314
Calorific Value Calculated From			6543	.....	.....
Ultimate Analysis			11777	.....	.....

## UNION COUNTY.

No. 123.

Laboratory number ..... 3,678  
 Coal ..... Bell  
 Location ..... 2½ miles S. W. of Sturgis  
 Location in mine ..... Left entry No. 1,  
 100 feet north from drift at foot of slope.  
 Date of sampling ..... 9-1-'06

## SECTION OF MINE.

Roof—Shale		Feet	Inches
1. Coal .....		.....	3
2. Mother coal .....		.....	1
3. Coal .....		1	.....
4. Mother coal .....		.....	¾
5. Coal .....		1	2½
Total .....		2	7¼
Floor—fire clay.			
Excluded from sample, none.			
Air-dry Loss, 5.1		Coal	
Proximate Analysis	Moisture .....	7.46	.....
	Volatile matter ..	30.69	.....
	Fixed carbon ..	57.25	.....
	Ash .....	4.60	.....
		100.00	.....
Sulphur		0.97	.....
Calorific Value Determined	Calories .....	7494	.....
	B. T. U. ....	13489	.....

## UNION COUNTY.

No. 124.

Laboratory number ..... 3,679  
 Coal ..... Bell  
 Location ..... 2½ miles S. W. of Sturgis  
 Location in mine ..... Room 1, left entry No. 1,  
 60 feet N. from drift at foot of slope.  
 Date of sampling ..... 9-1-'06

## SECTION OF MINE.

Roof—Shale		Feet	Inches
1. Coal			10½
2. Mother coal			½
3. Coal			10
4. Mother coal			¼
5. Coal			5
6. Mother coal			¾
7. Coal			7
Total		2	9¾
Floor—fire clay.			
Excluded from sample, none.			

Air-dry Loss, 5.7		Coal	
Proximate Analysis	Moisture	8.09	
	Volatile matter	30.10	
	Fixed carbon	56.65	
	Ash	5.16	
		100.00	
Sulphur		1.07	
Calorific Value Determined	Calories	7355	
	B. T. U.	13239	

## UNION COUNTY.

No. 125.

Laboratory number ..... 18,993  
 Operator ..... River, Rail Coal and Coke Co.  
 Mine (shaft) ..... River, Rail C. & C. Co.  
 Coal ..... No. 11  
 Location ..... 1½ miles S. E. of Uniontown  
 Location in mine ..... Face of main east,  
 1,400 feet from shaft.  
 Date of sampling ..... 3-28-'14  
 Date of analysis ..... 4-15-'14  
 Depth below surface ..... 189 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 12	Inches
Black Slate			6
1. Coal			10½
2. Sulphur band			1
3. Coal			3¼
4. Mother coal			¼
5. Coal streaked with sulphur	1		5
6. Sulphur band			¼
7. Coal streaked with sulphur			9
8. "Blue band"			1½
9. Coal streaked with sulphur and clay	1		
Total	4		6¾
Floor—soft fire clay.			
Excluded from sample, Nos. 2-8.			

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	5.90	9.31		
	Volatile matter	39.70	38.26	42.19	47.15
	Fixed carbon	44.50	42.89	47.29	52.85
	Ash	9.90	9.54	10.52	
		100.00	100.00	100.00	100.00
Sulphur		3.73	3.59	3.96	4.43
Calorific Value Determined	Calories	6713	6470	7134	7973
	B. T. U.	12083	11646	12841	14351

## UNION COUNTY.

No. 126.

Laboratory number .....18,994  
 Operator .....River, Rail Coal and Coke Co.  
 Mine (shaft) .....River, Rail C. and C. Co.  
 Location .....1½ miles S. E. of Uniontown  
 Location in mine.....Face of main west,  
 1,330 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....3-27-'14  
 Date of analysis .....4-10-'14  
 Depth below surface .....189 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 12	Inches
1.	Coal adhering to roof.....		1½
2.	Coal streaked with sulphur.....		5
3.	Hard sulphur band.....		1
4.	Coal streaked with sulphur.....	2	6¾
5.	"Blue band".....		1
6.	Coal.....		1¾
7.	Hard sulphur band.....		½
8.	Coal.....		2
9.	Mother coal.....		¾
10.	Coal.....		7
Total.....		4	2¾
Floor—fire clay.			
Excluded from sample, Nos. 1-3-5-6-7.			

Air-dry Loss, 4.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture.....	5.90	9.64		
	Volatile matter ..	38.80	37.26	41.24	45.57
	Fixed carbon .....	46.35	44.51	49.25	54.43
	Ash.....	8.95	8.59	9.51	.....
		100.00	100.00	100.00	100.00
Sulphur		3.26	3.13	3.46	3.32
Calorific Value Determined	Calories .....	6798	6528	7225	7984
	B. T. U. ....	12236	11750	13005	14371

## UNION COUNTY.

No. 127.

Laboratory number .....18,995  
 Operator .....River, Rail Coke and Coal Co.  
 Mine (shaft) .....River, Rail C. and C. Co.  
 Location .....1½ miles S. E. of Uniontown  
 Location in mine.....Face of room 24, off first south on east side,  
 1,285 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....3-28-'14  
 Date of analysis .....4-15-'14  
 Depth below surface .....189 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 12	Inches
Black Shale		1	
1. Coal .....			11½
2. Sulphur band .....			¾
3. Coal .....	1		
4. Thin sulphur band .....			
5. Coal with mother coal in lower 10 inches.....	1		5
6. "Blue band" .....			2½
7. Coal with sulphur .....			10¾
Total .....	4		6
Floor—medium soft fire clay.			
Excluded from sample, Nos. 2-6.			

Air-dry Loss, 3.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.35	8.81		
	Volatile matter ..	39.05	37.62	41.25	46.83
	Fixed carbon .....	44.32	42.70	46.83	53.17
	Ash .....	11.28	10.87	11.92	
		100.00	100.00	100.00	100.00
Sulphur		4.36	4.20	4.61	5.23
Calorific Value Determined	Calories .....	6613	6371	6986	7931
	B. T. U. ....	11903	11468	12575	14276

## UNION COUNTY.

No. 128.

Laboratory number .....18,996  
 Operator .....River, Rail Coal and Coke Co.  
 Mine (shaft).....River, Rail C. and C. Co.  
 Location .....1½ miles S. E. of Uniontown  
 Location in mine.....Face of first south, off west main,  
 30 feet beyond room 22.  
 Coal .....No. 11  
 Date of sampling .....3-27-14  
 Date of analysis .....4-10-14  
 Depth below surface .....189 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 12	Inches
Black Slate			
1. Coal .....			11
2. Sulphur band .....			¾
3. Coal with lenses of mother coal.....			11½
4. Mother coal .....			½
5. Coal .....		1	5
6. "Blue band" .....			1½
7. Coal .....			1
8. Sulphur .....			½
9. Coal with disseminated sulphur.....			11
Total .....		4	6¾
Floor—fire clay.			
Excluded from sample, Nos. 2-6-7-8.			

Air-dry Loss, 4.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.57	9.37		
	Volatile matter ..	39.63	38.04	41.97	46.05
	Fixed carbon .....	46.42	44.55	49.16	53.95
	Ash .....	8.38	8.04	8.87	
		100.00	100.00	100.00	100.00
Sulphur		3.55	3.41	3.76	4.13
Calorific Value Determined	Calories .....	6861	6585	7266	7973
	B. T. U. ....	12350	11853	13079	14351

## UNION COUNTY.

No. 129.

Laboratory number .....18,997  
 Operator .....River, Rail Coal and Coke Co.  
 Mine (shaft).....River, Rail C. and C. Co.  
 Location .....1½ miles S. E. of Uniontown  
 Location in mine.....Face of 3rd south entry,  
 1,290 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....3-27-14  
 Date of analysis .....4-10-14  
 Depth below surface .....189 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 12	Inches
Black Shale			4
1. Coal			11
2. Sulphur band			¾
3. Coal			11
4. Sulphur band			¾
5. Coal		1	2
6. Sulphur lens			½
7. Coal with thin streaks of sulphur			5
8. "Blue band"			3
9. Impure coal with sulphur		1	
Total		4	10
Floor—fire clay.			
Excluded from sample, Nos. 2-4-8.			

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	6.00	9.42		
	Volatile matter	38.90	37.48	41.38	46.42
	Fixed carbon	44.90	43.27	47.77	53.58
	Ash	10.20	9.83	10.85	
		100.00	100.00	100.00	100.00
Sulphur		3.76	3.62	4.00	4.49
Calorific Value Determined	Calories	6677	6434	7103	7967
	B. T. U.	12019	11581	12785	14341

## UNION COUNTY.

No. 130.

Laboratory number .....18,998F  
(Composite of numbers 18,993-94-95-96-97.)

Operator .....River, Rail Coal and Coke Co.  
Mine (shaft) .....River, Rail C. and C. Co.  
Location .....1½ miles S. E. of Uniontown  
Coal .....No. 11  
Date of analysis .....4-10-'14

Air-dry Loss, 3.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.75	9.31	.....	.....
	Volatile matter ..	39.25	37.77	41.65	46.43
	Fixed carbon .	45.30	43.59	48.06	53.57
	Ash .....	9.70	9.33	10.29	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.25	5.47	4.90	5.46
	Carbon .....	66.83	64.30	70.90	79.03
	Nitrogen .....	1.37	1.32	1.46	1.63
	Oxygen .....	13.13	16.00	8.50	9.48
	Sulphur .....	8.72	3.58	3.95	4.40
		9.70	9.33	10.29	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6732	6478	7143	7962
	B. T. U. ....	12118	11660	12857	14332
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6472	.....	.....
	B. T. U. ....	.....	11650	.....	.....

## UNION COUNTY.

No. 131.

Laboratory number .....19,055  
Operator .....Morganfield Coal and Mining Company  
Mine (shaft) .....Morganfield C. & M. Co.  
Locality .....½ mile north of Morganfield  
Location in mine.....Face of 5th north entry,  
2,400 feet from shaft.

Coal .....No. 11  
Date of sampling .....3-30-'14  
Date of analysis .....4-14-'14  
Depth below surface .....225 feet

## SECTION OF MINE.

Roof—Limestone		Feet 4 to 5	Inches
Gray Slate			3
1. Coal streaked with sulphur.....		1	1¾
2. Sulphur band .....			½
3. Soft coal streaked with sulphur.....		2	1¾
4. Sulphur band .....			½
5. Coal .....			3¼
6. "Blue band" .....			2½
7. Coal streaked with sulphur .....			8¼
Total .....		4	6½
Floor—soft, shaly fire clay.			
Excluded from sample, Nos. 2 and 6.			

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.30	8.41	.....	.....
	Volatile matter ..	38.90	37.62	41.07	45.89
	Fixed carbon .....	45.85	44.35	48.43	54.11
	Ash .....	9.95	9.62	10.50	.....
		100.00	100.00	100.00	100.00
Sulphur		3.78	3.66	4.00	4.47
Calorific Value Determined	Calories .....	6773	6551	7152	7991
	B. T. U. ....	12191	11792	12874	14384

## UNION COUNTY.

No. 132.

Laboratory number .....19,056  
 Operator .....Morganfield Coal and Mining Company  
 Mine (shaft) .....Morganfield C. & M. Co.  
 Locality .....½ mile north of Morganfield  
 Location in mine.....Face of room 16, of third south entry,  
 1,600 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....3-30-'14  
 Date of analysis .....4-14-'14  
 Depth below surface .....225 feet

## SECTION OF MINE.

Roof—Limestone	Feet 3 to 4	Inches
Black Shale		0 to 16
1. Coal .....	1	.....
2. Mother coal (thin) .....		.....
3. Coal with vert. sulphur bands.....	2	.....
4. Thin sulphur band .....		.....
5. Coal .....	3	.....
6. Thin sulphur band .....		.....
7. Coal .....	3	.....
8. "Blue band" .....	2	.....
9. Coal with sulphur .....	9	.....
Total .....	4	5
Floor—fire clay. Excluded from sample, No. 8.		

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.75	7.89	.....	.....
	Volatile matter ..	39.35	38.05	41.31	46.20
	Fixed carbon .....	45.82	44.31	48.10	53.80
	Ash .....	10.08	9.75	10.59	.....
		100.00	100.00	100.00	100.00
Sulphur		4.13	3.99	4.33	4.84
Calorific Value Determined	Calories .....	6801	6577	7141	7986
	B. T. U. ....	12242	11839	12854	14375

## UNION COUNTY.

No. 133.

Laboratory number .....19,057  
 Operator .....Morganfield Coal and Mining Company  
 Mine (shaft) .....Morganfield C. & M. Co.  
 Location .....½ mile north of Morganfield  
 Location in mine.....Face of room 30, off first south, off west main,  
 1,700 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....3-30-'14  
 Date of analysis .....4-23-'14  
 Depth below surface .....225 feet

## SECTION OF MINE.

Roof—Limestone	Feet 4 to 5	Inches
Black Slate		6
1. Coal streaked with sulphur.....	1	.....
2. Sulphur band .....		½
3. Coal .....		3½
4. Mother coal .....		¼
5. Coal streaked with sulphur.....	2	.....
6. "Blue band" .....		2½
7. Coal with sulphur .....		6
8. Coal with sulphur and clay.....		4½
Total .....	4	5
Floor—hard fire clay. Excluded from sample, Nos. 2-6-8.		

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	4.33	7.48	.....	.....
	Volatile matter ..	39.67	38.36	41.46	47.56
	Fixed carbon .....	43.73	42.29	45.71	52.44
	Ash .....	12.27	11.87	12.83	.....
		100.00	100.00	100.00	100.00
Sulphur		4.69	4.54	4.91	5.63
Calorific Value Determined	Calories .....	6603	6386	6902	7918
	B. T. U. ....	11885	11495	12424	14252

## UNION COUNTY.

No. 134.

Laboratory number .....19,058  
 Operator .....Morganfield Coal and Mining Company  
 Mine (shaft) .....Morganfield C. & M. Co.  
 Coal .....No. 11  
 Location .....½ mile north of Morganfield  
 Location in mine.....Face of room 28, of second south,  
 1,800 feet from shaft.  
 Date of sampling .....3-30-'14  
 Date of analysis .....4-17-'14  
 Depth below surface .....225 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 4	Inches
Black Shale			6
1. Coal .....		1	.....
2. Sulphur band .....			1
3. Coal streaked with mother coal .....		1	7½
4. Thin sulphur band .....			.....
5. Coal .....			4½
6. Thin sulphur band .....			.....
7. Coal .....			3½
8. "Blue band" .....			2
9. Coal .....			8
10. Sulphur and coal mixed.....			1
Total .....		4	3½
Floor—soft fire clay.			
Excluded from sample, Nos. 2-8-10.			

Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	5.12	8.18	.....	.....
	Volatile matter ..	39.38	38.11	41.51	46.29
	Fixed carbon .....	45.70	44.23	48.17	53.71
	Ash .....	9.80	9.48	10.32	.....
		100.00	100.00	100.00	100.00
Sulphur		4.35	4.21	4.59	5.12
Calorific Value Determined	Calories .....	6777	6559	7143	7965
	B. T. U. ....	12199	11806	12857	14337

## UNION COUNTY.

No. 135.

Laboratory number .....19,059  
 (Composite of 19,055-56-57-58.)  
 Operator .....Morganfield Coal and Mining Co.  
 Mine (shaft) .....Morganfield C. & M. Co.  
 Locality .....½ mile north of Morganfield  
 Coal .....No. 11  
 Date of analysis .....4-16-'14

Air-dry Loss, 3.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	4.85	7.96		
	Volatile matter	39.75	38.45	41.78	47.04
	Fixed carbon	44.75	43.29	47.03	52.96
	Ash	10.65	10.30	11.19	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen	5.14	5.33	4.83	5.44
	Carbon	67.03	64.84	70.45	79.33
	Nitrogen	1.38	1.33	1.45	1.63
	Oxygen	11.51	14.05	7.57	8.52
	Sulphur	4.29	4.15	4.51	5.08
	Ash	10.65	10.30	11.19	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories	6751	6530	7095	7989
	B. T. U.	12152	11754	12771	14380
Calorific Value Calculated From Ultimate Analysis	Calories		6563		
	B. T. U.		11813		

## UNION COUNTY.

No. 136.

Laboratory number .....19,071  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....On I. C. R. R., two miles N. W. of Sturgis  
 Location in mine .....Rib of third west entry,  
 850 feet from entrance of slope.  
 Coal .....No. 9  
 Date of sampling .....4-1-'14  
 Date of analysis .....4-23-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal .....			8
2. Impure coal with sulphur.....			1½
3. Coal .....		2	3½
4. Mother coal .....			½
5. Coal .....		1	3
6. Coal streaked with sulphur.....			5
7. Coal .....			5½
Total .....		5	3
Floor—hard fire clay, 2½ feet. Excluded from sample, none.			

Air-dry Loss, 1.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.75	3.50		
	Volatile matter ..	38.83	38.14	39.52	44.21
	Fixed carbon .....	48.99	48.12	49.87	55.79
	Ash .....	10.43	10.24	10.61	
		100.00	100.00	100.00	100.00
Sulphur		3.78	3.71	3.84	4.30
Calorific Value Determined	Calories .....	7274	7145	7404	8283
	B. T. U. ....	13093	12861	13327	14909

## UNION COUNTY.

No. 137.

Laboratory number .....19,072  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....On I. C. R. R., 2 miles N. W. of Sturgis  
 Location in mine .....Face of fourth west air course,  
 1,800 feet from entrance of slope.  
 Coal .....No. 9  
 Date of sampling .....4-1-'14  
 Date of analysis .....4-18-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal .....			8
2. Sulphur band .....			¼
3. Coal .....		2	10½
4. Coal streaked with sulphur .....			5
5. Coal .....		1	1
Total .....		5	0¾
Floor—hard fire clay, 2½ feet. Excluded from sample, none.			

Air-dry Loss, 4.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.78	6.19	.....	.....
	Volatile matter ..	38.42	36.69	39.11	44.86
	Fixed carbon .....	47.22	45.10	48.08	55.14
	Ash .....	12.58	72.02	12.81	.....
		100.00	100.00	100.00	100.00
Sulphur		4.82	4.60	4.90	5.62
Calorific Value Determined	Calories .....	7067	6750	7196	8253
	B. T. U. ....	12721	12150	12953	14855

## UNION COUNTY.

No. 138.

Laboratory number .....19,073  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....On I. C. R. R., two miles N. W. of Sturgis  
 Location in mine .....Rib of main slope entry,  
 2,000 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-1-'14  
 Date of analysis .....4-18-'14

## SECTION OF MINE.

Roof—Black Slate	Feet 3	Inches
1. Coal .....		11
2. Sulphur band .....		1 <sup>1</sup> / <sub>2</sub>
3. Coal .....	1	1 <sup>1</sup> / <sub>2</sub>
4. Mother coal .....		3 <sup>1</sup> / <sub>4</sub>
5. Coal .....		7
6. Mother coal .....		1 <sup>1</sup> / <sub>2</sub>
7. Coal .....		9
8. Mother coal .....		1 <sup>1</sup> / <sub>4</sub>
9. Coal .....		11
10. Sulphur band .....		1 <sup>1</sup> / <sub>2</sub>
11. Coal .....	1	2 <sup>1</sup> / <sub>2</sub>
Total .....	5	7 <sup>1</sup> / <sub>4</sub>
Floor—hard fire clay. Excluded from sample, none.		

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.78	4.42		
	Volatile matter ..	38.92	37.87	39.62	44.85
	Fixed carbon .....	47.85	46.57	48.73	55.15
	Ash .....	11.45	11.14	11.65	
		100.00	100.00	100.00	100.00
Sulphur		3.04	2.96	3.10	3.51
Calorific Value Determined	Calories .....	7176	6983	7306	8270
	B. T. U. ....	12917	12569	13151	14886

## UNION COUNTY.

No. 139.

Laboratory number .....19,074  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....On I. C. R. R., two miles N. W. of Sturgis  
 Location in mine .....Face of fourth east level,  
 2,098 feet from entrance of slope.  
 Coal .....No. 9  
 Date of sampling .....4-1-'14  
 Date of analysis .....4-18-'14  
 Depth below surface .....150 feet

## SECTION OF MINE.

Roof—Black slate	Feet 4	Inches
1. Coal, brittle and glossy .....		10
2. Sulphur band .....		3 <sup>1</sup> / <sub>4</sub>
3. Coal .....		3 <sup>1</sup> / <sub>2</sub>
4. Mother coal .....		1 <sup>1</sup> / <sub>4</sub>
5. Coal .....		5 <sup>3</sup> / <sub>4</sub>
6. Mother coal .....		1 <sup>1</sup> / <sub>4</sub>
7. Coal streaked with mother coal.....		9 <sup>3</sup> / <sub>4</sub>
8. Mother coal .....		1 <sup>1</sup> / <sub>2</sub>
9. Coal with sulphur and mother coal.....	1	2 <sup>1</sup> / <sub>2</sub>
10. Mother coal .....		1 <sup>1</sup> / <sub>4</sub>
11. Coal streaked with sulphur.....		3
12. Mother coal .....		1 <sup>1</sup> / <sub>4</sub>
13. Coal mixed with sulphur.....		10 <sup>1</sup> / <sub>2</sub>
Total .....	4	10 <sup>3</sup> / <sub>4</sub>
Floor—hard, smooth fire clay. Excluded from sample, none.		

Air-dry Loss, 2.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.90	3.97		
	Volatile matter ..	37.06	36.28	37.78	42.57
	Fixed carbon .....	50.01	48.95	50.97	57.43
	Ash .....	11.03	10.80	11.25	
		100.00	100.00	100.00	100.00
Sulphur		4.28	4.19	4.36	4.91
Calorific Value Determined	Calories .....	7177	7026	7316	8244
	B. T. U. ....	12918	12647	13169	14839

## UNION COUNTY.

No. 140.

Laboratory number .....19,075  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....Two miles N. W. of Sturgis  
 Location in mine.....Face of third east level,  
 2,000 feet from entrance of slope.  
 Coal .....No. 9  
 Date of sampling .....4-1-'14  
 Date of analysis .....4-23-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal .....			2½
2. Sulphur band .....			¼
3. Coal .....			4½
4. Sulphur band .....			¼
5. Coal streaked with sulphur and mother coal.....	1		1½
6. Mother coal .....			¼
7. Coal streaked with sulphur.....	3		
Total .....	4		9¼
Floor—hard, smooth fire clay, 2½ feet. Excluded from sample, none.			

Air-dry Loss, 2.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.88	3.86		
	Volatile matter ..	37.37	36.62	38.09	43.17
	Fixed carbon .....	49.20	48.20	50.14	56.83
	Ash .....	11.55	11.32	11.77	
		100.00	100.00	100.00	100.00
Sulphur		4.66	4.57	4.75	5.38
Calorific Value Determined	Calories .....	7112	6968	7247	8214
	B. T. U. ....	12802	12542	13045	14785

## UNION COUNTY.

No. 141.

Laboratory number .....19,076F  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....West Kentucky No. 8  
 Location .....Two miles N. W. of Sturgis  
 Location in mine.....Composite of Nos. 19,071-2-3-4-5  
 Coal .....No. 9  
 Date of analysis .....4-18-'14

Air-dry Loss, 2.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.75	4.32		
	Volatile matter ..	38.24	37.24	38.92	44.04
	Fixed carbon .....	48.58	47.31	49.45	55.96
	Ash .....	11.43	11.13	11.63	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	4.96	5.12	4.85	5.49
	Carbon .....	70.98	69.12	72.24	81.75
	Nitrogen .....	1.57	1.53	1.60	1.81
	Oxygen .....	6.98	9.13	5.53	6.25
	Sulphur .....	4.08	3.97	4.15	4.70
	Ash .....	11.43	11.13	11.63	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7167	6979	7294	8254
	B. T. U. ....	12901	12562	13129	14857
Calorific Value Calculated From Ultimate Analysis		Calories .....	7046		
		B. T. U. ....	12683		

## UNION COUNTY.

No. 142.

Laboratory number .....19,081  
 Operator .....West Kentucky Coal Company  
 Mine (shaft) .....West Kentucky No. 9  
 Location .....1½ miles N. E. of Sturgis  
 Location in mine.....Face of east entry,  
 135 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-3-'14  
 Date of analysis .....4-20-'14  
 Depth below surface .....400 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 4	Inches
1.	Coal adhering to roof.....		1
2.	Coal .....		6
3.	Coal mixed with sulphur .....		%
4.	Coal .....		10
5.	Coal high in sulphur .....		1½
6.	Coal .....	1	4
7.	Coal high in sulphur .....		4
8.	Coal .....		7
9.	Sulphur band .....		1
10.	Coal .....		10½
Total .....		4	9%
Floor—hard fire clay.			
Excluded from sample, Nos. 8 and 10.			

Air-dry Loss, 1.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.85	3.36		
	Volatile matter ..	36.83	36.26	37.52	42.51
	Fixed carbon ..	49.79	49.03	50.74	57.49
	Ash .....	11.53	11.35	11.74	
		100.00	100.00	100.00	100.00
Sulphur		5.05	4.97	5.14	5.22
Calorific Value Determined	Calories .....	7147	7037	7282	8251
	B. T. U. ....	12865	12667	13108	14852

## UNION COUNTY.

No. 143.

Laboratory number .....19,082  
 Operator .....West Kentucky Coal Company  
 Mine (shaft) .....West Kentucky No. 9  
 Location .....1½ miles N. E. of Sturgis  
 Location in mine.....Face of main west entry,  
 400 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-3-'14  
 Date of analysis .....4-20-'14  
 Depth below surface .....400 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 4	Inches
Draw Slate			1½
1. Coal .....			8
2. Coal mixed with sulphur.....			½
3. Coal .....			6
4. Coal mixed with sulphur.....			1
5. Coal .....			5
6. Coal mixed with sulphur.....			1
7. Coal .....			5½
8. Mother coal .....			¼
9. Coal .....	1		
10. Coal mixed with sulphur.....			1
11. Coal with thin sulphur band, 1½ in. from bottom	1		1
12. Tough, dull coal .....			6
13. Coal, hard and bright.....			1½
Total .....		5	0%
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.83	3.84		
	Volatile matter ..	36.57	35.82	37.25	42.24
	Fixed carbon .....	50.00	48.98	50.94	57.76
	Ash .....	11.60	11.36	11.81	
		100.00	100.00	100.00	100.00
Sulphur		3.82	3.74	3.89	4.41
Calorific Value Determined	Calories .....	7135	6939	7268	8241
	B. T. U. ....	12843	12580	13082	14834

## UNION COUNTY.

No. 144.

Laboratory number .....19,083  
 Operator .....West Kentucky Coal Company  
 Mine .....West Kentucky No. 9  
 Location .....1½ miles N. E. of Sturgis  
 Location in mine.....Face of main east entry,  
                                     450 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-3-'14  
 Date of analysis .....4-21-'14  
 Depth below surface .....400 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 4	Inches
1. Hard coal mixed with sulphur.....		1	2
2. Sulphur band .....			1½
3. Coal mixed with sulphur.....		1	1
4. Sulphur band .....			1¼
5. Coal mixed with sulphur .....			6¼
6. Sulphur ball .....			1
7. Hard coal with variable sulphur.....		1	9
Total .....		4	10
Floor—hard, smooth fire clay. Excluded from sample, Nos. 2-4-6.			

Air-dry Loss, 1.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.93	3.50	.....	.....
	Volatile matter ..	38.30	37.69	39.06	43.49
	Fixed carbon .....	49.79	48.99	50.76	56.51
	Ash .....	9.98	9.82	10.18	.....
		100.00	100.00	100.00	100.00
Sulphur		3.63	3.57	3.70	4.12
Calorific Value Determined	Calories .....	7259	7143	7402	8241
	B. T. U. ....	13066	12857	13324	14834

## UNION COUNTY.

No. 145.

Laboratory number .....19,084  
 Operator .....West Kentucky Coal Company  
 Mine .....West Kentucky No. 9  
 Location .....1½ miles N. E. of Sturgis  
 Location in mine.....75 feet N. W. of shaft, called west entry track  
 Coal .....No. 9  
 Date of sampling .....4-3-'14  
 Date of analysis .....4-20-'14  
 Depth below surface .....400 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 1	Inches
1. Coal adhering to roof.....			2
2. Coal with sulphur streaks .....			3
3. Coal, glossy with some sulphur.....			11
4. Sulphur band .....			1
5. Coal, soft and brittle .....	1		1½
6. Sulphur ball .....			4
7. Hard coal streaked with sulphur.....	2		2
Total .....		5	0½
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 1-2-4-6.			

Air-dry Loss, 1.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.93	3.71		
	Volatile matter ..	38.34	37.64	39.09	42.84
	Fixed carbon .....	51.13	50.21	52.15	57.16
	Ash .....	8.60	8.44	8.76	
		100.00	100.00	100.00	100.00
Sulphur		3.33	3.27	3.40	3.73
Calorific Value Determined	Calories .....	7399	7264	7544	8268
	B. T. U. ....	13315	13075	13579	14832

## UNION COUNTY.

No. 146.

Laboratory number .....19,085  
 (Composite of 19,081-2-3-4.)  
 Operator ..... West Kentucky Coal Company  
 Mine ..... West Kentucky No. 9  
 Locality ..... 1½ miles N. E. of Sturgis  
 Coal ..... No. 9  
 Date of analysis ..... 4-20-'14

Air-dry Loss, 1.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.83	3.55	.....	.....
	Volatile matter ..	37.37	36.71	38.06	42.62
	Fixed carbon .....	50.30	49.42	51.24	57.38
	Ash .....	10.50	10.32	10.70	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.05	5.15	4.94	5.53
	Carbon .....	71.97	70.71	73.31	82.09
	Nitrogen .....	1.61	1.58	1.64	1.84
	Oxygen .....	6.82	8.26	5.28	5.92
	Sulphur .....	4.05	3.98	4.13	4.62
	Ash .....	10.50	10.32	10.70	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7227	7110	7372	8255
	B. T. U. ....	13027	12798	13270	14859
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	7223	.....	.....
	B. T. U. ....	.....	13001	.....	.....

## UNION COUNTY.

No. 147.

Laboratory number .....19,169  
 Operator.....Ohio Valley Coal and Mining Company  
 Mine (slope) .....DeKoven  
 Location .....¾ mile N. E. from DeKoven Station  
 Location in mine.....Face of 6th west entry,  
 1¼ miles from entrance.  
 Coal ..... No. 9  
 Date of sampling ..... 4-2-'14  
 Date of analysis ..... 5-3-'14  
 Depth below surface ..... 200 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal .....		2	7
2. Sulphur ball .....			5
3. Coal .....			2
4. Mother coal .....			¾
5. Coal .....		1	1½
Total .....		4	4
Floor—hard fire clay. Excluded from sample, No. 2.			

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.95	4.43		
	Volatile matter ..	38.45	37.48	39.22	43.85
	Fixed carbon .....	49.25	48.00	50.22	56.15
	Ash .....	10.35	10.09	10.56	
		100.00	100.00	100.00	100.00
Sulphur		2.52	2.46	2.57	2.87
Calorific Value Determined	Calories .....	7152	6971	7294	8155
	B. T. U. ....	12874	12548	13129	14679

## UNION COUNTY.

No. 148.

Laboratory number .....19,170  
 Operator.....Ohio Valley Coal and Mining Company  
 Mine (slope) .....DeKoven  
 Location ..... $\frac{3}{4}$  mile N. E. from DeKoven Station  
 Location in mine.....Face of No. 7 west,  
                                     1 $\frac{1}{4}$  miles from entrance.  
 Coal .....No. 9  
 Date of sampling .....4-2-'14  
 Date of analysis .....5-16-'14  
 Depth below surface .....375 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 4	Inches
1. Coal .....			8¾
2. Sulphur band .....			¼
3. Coal streaked with sulphur.....	1		3¼
4. Mother coal .....			¼
5. Coal streaked with sulphur.....	1		3¾
6. Sulphur band .....			¼
7. Coal streaked with sulphur .....	1		1
Total .....		4	5¾
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 2.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.83	4.34		
	Volatile matter ..	37.02	36.07	37.71	43.02
	Fixed carbon .....	49.02	47.77	49.94	56.98
	Ash .....	12.13	11.82	12.35	
		100.00	100.00	100.00	100.00
Sulphur		4.09	3.99	4.17	4.76
Calorific Value Determined	Calories .....	7049	6869	7181	8193
	B. T. U. ....	12688	12364	12926	14747

## UNION COUNTY.

No. 149.

Laboratory number .....19,171  
 Operator.....Ohio Valley Coal and Mining Company  
 Mine (slope) .....DeKoven  
 Location ..... $\frac{3}{4}$  mile N. E. from DeKoven Station  
 Location in mine.....Face of 6th east level,  
                                     8,400 feet from entrance.  
 Coal .....No. 9  
 Date of sampling .....3-31-'14  
 Date of analysis .....5-8-'14  
 Depth below surface .....150 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal .....			6½
2. Sulphur band .....			¼
3. Coal streaked with sulphur.....			5½
4. Sulphur band .....			¼
5. Coal streaked with sulphur.....	1		8½
6. Sulphur band .....			¼
7. Coal streaked with sulphur.....			11
8. Sulphur band .....			¼
9. Coal mixed with sulphur .....			9
Total .....		4	5½
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 3.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.83	5.37		
	Volatile matter ..	37.07	35.73	37.76	44.45
	Fixed carbon .....	46.32	44.65	47.18	55.55
	Ash .....	14.78	14.25	15.06	
		100.00	100.00	100.00	100.00
Sulphur		3.88	3.74	3.95	4.65
Calorific Value Determined	Calories .....	6744	6501	6870	8088
	B. T. U. ....	12139	11702	12366	14558

## UNION COUNTY.

No. 150.

Laboratory number ..... 19,172  
 Operator ..... Ohio Valley Coal and Mining Company  
 Mine (slope) ..... DeKoven  
 Location .....  $\frac{1}{4}$  mile N. E. of DeKoven Station  
 Location in mine ..... Face of 7th E. level,  
 3,900 feet from foot of slope.  
 Coal ..... No. 9  
 Date of sampling ..... 3-31-'14  
 Date of analysis ..... 5-8-'14  
 Depth below surface ..... 250 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal .....			7½
2. Thin sulphur band .....			¾
3. Coal .....	1	3	
4. Sulphur band .....			¾
5. Coal .....			1¾
6. Sulphur band .....			¼
7. Coal .....	1	2	
8. Thin sulphur band.....			
9. Coal .....			6
10. Sulphur band .....			¾
11. Coal .....			10
Total .....		4	7½ <sub>20</sub>
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.97	4.06		
	Volatile matter ..	35.98	35.21	36.70	41.27
	Fixed carbon .....	51.19	50.10	52.22	58.73
	Ash .....	10.86	10.63	11.08	
		100.00	100.00	100.00	100.00
Sulphur		4.64	4.54	4.73	5.32
Calorific Value Determined	Calories .....	7133	6981	7276	8183
	B. T. U. ....	12839	12566	13097	14729

## UNION COUNTY.

No. 151.

Laboratory number ..... 19,173  
 Operator ..... Ohio Valley Coal and Mining Company  
 Mine (slope) ..... DeKoven  
 Location .....  $\frac{1}{4}$  mile N. E. from DeKoven Station  
 Location in mine ..... Neck of room No. 8 on 12th rise, off 6th entry,  
 8,000 feet from foot of slope.  
 Coal ..... No. 9  
 Date of sampling ..... 3-31-'14  
 Date of analysis ..... 5-8-'14  
 Depth below surface ..... 125 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
1. Coal			10
2. Thin sulphur band			
3. Coal		1	9½
4. Mother coal			½
5. Coal		1	1½
6. Mother coal and thin sulphur			
7. Coal			3½
8. Thin sulphur			
9. Coal			8
Total		4	9
Floor—hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	1.92	4.02		
	Volatile matter	37.38	36.58	38.11	44.14
	Fixed carbon	47.30	46.29	48.23	55.86
	Ash	13.40	13.11	13.66	
		100.00	100.00	100.00	100.00
Sulphur		3.13	3.06	3.19	3.69
Calorific Value Determined	Calories	6850	6703	6984	8089
	B. T. U.	12330	12065	12571	14560

## UNION COUNTY.

No. 152.

Laboratory number ..... 19,174  
 Operator ..... Ohio Valley Coal and Mining Company  
 Mine (slope) ..... DeKoven  
 Location .....  $\frac{3}{4}$  mile N. E. from DeKoven Station  
 Location in mine ..... Rib of 5th rise, off 7th west entry  
                                      $1\frac{1}{4}$  miles from entrance.  
 Coal ..... No. 9  
 Date of sampling ..... 4-2-'14  
 Date of analysis ..... 5-9-'14

## SECTION OF MINE.

Roof—Black Slate		Feet 3	Inches
Draw Slate			6
1. Coal			7½
2. Mother coal			½
3. Coal			6
4. Coal high in sulphur			1½
5. Coal with thin bands of mother coal		1	1½
6. Coal			10½
7. Mother coal			½
8. Coal			5
9. Thin sulphur			
10. Coal			3
11. Sulphur band			¾
12. Coal			5½
Total		4	6¼
Floor—hard fire clay.			
Excluded from sample, No. 11.			

Air-dry Loss, 2.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	2.03	4.20		
	Volatile matter	36.77	35.95	37.52	42.25
	Fixed carbon	50.24	49.13	51.29	57.75
	Ash	10.96	10.72	11.19	
		100.00	100.00	100.00	100.00
Sulphur		3.88	3.79	3.96	4.46
Calorific Value Determined	Calories	7134	6976	7282	8200
	B. T. U.	12841	12557	13108	14760

## UNION COUNTY.

No. 153.

Laboratory number ..... 19,175  
 (Composite of 19,169-70-71-72-73-74.)  
 Operator ..... Ohio Valley Coal and Mining Company  
 Mine (slope) ..... DeKoven  
 Location .....  $\frac{3}{4}$  mile N. E. of DeKoven Station  
 Date of analysis ..... 5-9-'14

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	1.89	4.37		
	Volatile matter	37.21	36.27	37.93	43.21
	Fixed carbon	48.91	47.67	49.85	56.79
	Ash	11.99	11.69	12.22	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen	4.88	5.04	4.76	5.42
	Carbon	70.03	68.26	71.38	81.32
	Nitrogen	1.48	1.44	1.51	1.72
	Oxygen	7.95	9.99	6.39	7.23
	Sulphur	3.67	3.58	3.74	4.26
	Ash	11.99	11.69	12.22	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories	7025	6847	7160	8157
	B. T. U.	12645	12325	12888	14683
Calorific Value Calculated From Ultimate Analysis		Calories	6902		
		B. T. U.	12424		

## UNION COUNTY.

No. 154.

Laboratory number .....19,114  
 Operator .....Crittenden Coal and Coke Company  
 Mine (drift) .....Crittenden C. & C. Co.  
 Location .....3½ miles N. W. of Sturgis  
 Location in mine... Face of room 22, off 2nd east, off main N. entry,  
 1,000 feet from entrance.  
 Coal .....No. 6  
 Date of sampling .....4-7-'14  
 Date of analysis .....4-24-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Dark Gray Slate		Feet	Inches
1. Coal .....			5
2. Thin sulphur .....			
3. Coal .....	1	6½	
4. Sulphur band .....		2½	
5. Coal .....	1	6½	
Total .....	3	8½	
Floor—fire clay.			
Excluded from sample, No. 4.			

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	1.95	4.36		
	Volatile matter ..	38.90	37.94	39.67	42.67
	Fixed carbon .....	52.25	50.97	53.29	57.33
	Ash .....	6.90	6.73	7.04	
		100.00	100.00	100.00	100.00
Sulphur		2.22	2.17	2.27	2.44
Calorific Value Determined	Calorics .....	7597	7410	7748	8335
	B. T. U. ....	13675	13338	13946	15003

## UNION COUNTY.

No. 155.

Laboratory number .....19,115  
 Operator .....Crittenden Coal and Coke Company  
 Mine (drift) .....Crittenden C. & C. Co.  
 Location .....3½ miles N. W. of Sturgis  
 Location in mine... Face of room 18, off second east, off north main,  
 2,200 feet from entrance.  
 Coal .....No. 6  
 Date of sampling .....4-7-'14  
 Date of analysis .....4-24-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Hard, Gray Shale		Feet 15	Inches
1. Coal streaked with sulphur .....		1	11½
2. Sulphur band .....			½
3. Coal .....			3
4. Sulphur band .....			½
5. Hard coal .....			7
6. Sulphur band .....			½
7. Hard coal .....			11
Total .....		3	10
Floor—soft, shaly fire clay, 8 feet.			
Excluded from sample, Nos. 2, 3, 4.			

Air-dry Loss, 2.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.20	4.43	...	...
	Volatile matter ..	38.00	37.13	38.85	42.81
	Fixed carbon .....	50.75	49.60	51.90	57.19
	Ash .....	9.05	8.84	9.25	...
		100.00	100.00	100.00	100.00
Sulphur		2.72	2.66	2.78	3.06
Calorific Value Determined	Calories .....	7393	7224	7559	8329
	B. T. U.	13307	13003	13606	14992

## UNION COUNTY.

No. 156.

Laboratory number .....19,116  
 Operator .....Crittenden Coal and Coke Company  
 Mine (drift) .....Crittenden C. & C. Co.  
 Location .....3½ miles N. W. of Sturgis  
 Location in mine.....Face of room 20, 2nd east entry off north main,  
 2,200 feet from entrance.  
 Coal .....No. 6  
 Date of sampling .....4-7-'14  
 Date of analysis .....4-24-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Hard, Gray Slate		Feet 15	Inches		
1. Coal streaked with sulphur.....		1	3		
2. Sulphur band .....			¾		
3. Coal streaked with sulphur.....		2	6		
Total .....		3	9½		
Floor—Shaly fire clay, 8 feet. Excluded from sample, No. 2.					
Air-dry Loss, 2.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.20	4.47		
	Volatile matter ..	37.75	36.87	38.60	42.53
	Fixed carbon .....	51.00	49.82	52.15	57.47
	Ash .....	9.05	8.84	9.25	
		100.00	100.00	100.00	100.00
Sulphur		3.02	2.95	3.09	3.40
Calorific Value Determined	Calories .....	7372	7201	7538	8306
	B. T. U. ....	13270	12962	13568	14951

## UNION COUNTY.

No. 157.

Laboratory number .....19,356F  
 (Composite of 19,114-15-16.)  
 Operator .....Crittenden Coal and Coke Company  
 Mine (drift) .....Crittenden C. & C. Co.  
 Location .....3½ miles N. W. of Sturgis  
 Date of analysis .....5-23-'14

Air-dry Loss, 2.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture ....	2.19	4.49		
	Volatile matter ..	37.51	36.63	38.35	41.97
	Fixed carbon .....	51.87	50.65	53.03	58.03
	Ash .....	8.43	8.23	8.62	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.24	5.88	5.11	5.59
	Carbon .....	74.07	72.33	75.73	82.87
	Nitrogen .....	1.66	1.62	1.70	1.86
	Oxygen .....	7.95	9.85	6.13	6.71
	Sulphur .....	2.65	2.59	2.71	2.97
	Ash .....	8.43	8.23	8.62	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7407	7233	7573	8287
	B. T. U. ....	13333	13019	13631	14917
Calorific Value Calculated From Ultimate Analysis		Calories .....	7333		
		B. T. U. ....	13199		

## WEBSTER COUNTY.

No. 158.

Laboratory number .....18,967  
 Operator .....Sebree Coal and Development Co.  
 Mine .....Sebree Coal and Development Co.'s  
 Coal .....No. 9  
 Location.....On L. & N. R. R., one-half mile north of Sebree  
 Location in mine.....From last room off air course of 2nd N. off E. entry,  
 1,400 feet from shaft.  
 Date of sampling .....3-26-'14  
 Date of analysis .....4-16-'14

Shaft mine.

## SECTION OF MINE.

Roof—Black Slate (Perrywinkle)		Feet	Inches
Black Shale			4
1. Coal			7
2. Sulphur, hard			$\frac{1}{4}$
3. Coal, hard, with sulphur bands			10
4. Coal	1		8
5. Sulphur, irregular			$\frac{1}{4}$
6. Coal, clean			10
Total	4		0
Floor, fire clay.			
Excluded from sample, No. 5.			

Air-dry Loss, 3.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	7.80	10.66		
	Volatile matter	38.20	37.02	41.44	46.09
	Fixed carbon	44.70	43.31	48.48	53.91
	Ash	9.30	9.01	10.08	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen				
	Carbon				
	Nitrogen				
	Oxygen				
	Sulphur	3.23	3.13	3.50	3.89
Calorific Value Determined	Calories	6602	6397	7160	7963
	B. T. U.	11884	11515	12883	14333

## WEBSTER COUNTY.

No. 159.

Laboratory number .....18,968  
 Operator .....Sebree Coal and Development Co.  
 Mine .....Sebree Coal and Development Co.'s  
 Coal .....No. 9  
 Location.....On L. & N. R. R.,  $\frac{1}{2}$  mile north of Sebree  
 Location in mine.....Face of second north of east entry,  
 1,600 feet from shaft.  
 Date of sampling .....3-26-'14  
 Date of analysis .....4-14-'14  
 Depth below surface (shaft) .....170 feet

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
Black Shale			4
1. Coal			7
2. Sulphur band			$\frac{1}{4}$
3. Coal			8 $\frac{1}{2}$
4. Coal and sulphur			$\frac{1}{2}$
5. Coal			7 $\frac{1}{2}$
6. Mother coal			$\frac{1}{4}$
7. Coal	1		0
8. Bone and sulphur			$\frac{1}{4}$
9. Coal			8
10. Coal and sulphur mixed			3 $\frac{1}{2}$
Total	4		0
Floor—fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	7.40	9.70		
	Volatile matter	38.00	37.06	41.04	46.68
	Fixed carbon	43.40	42.32	46.87	53.32
	Ash	11.20	10.92	12.09	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen				
	Carbon				
	Nitrogen				
	Oxygen				
	Sulphur	3.90	3.80	4.21	4.79
Calorific Value Determined	Calories	6391	6233	6902	7851
	B. T. U.	11504	11219	12424	14132

## WEBSTER COUNTY.

No. 160.

Laboratory number .....18,969F  
 (Composite of 18,967 and 18,968.)  
 Operator .....Sebree Coal and Development Co.  
 Mine.....Sebree Coal and Development Co.'s  
 Coal .....No. 9  
 Location .....L. & N. R. R., ½ mile north of Sebree  
 Date of analysis .....4-16-'14

Air-dry Loss, 2.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	7.50	10.08	.....	.....
	Volatile matter ..	38.20	37.13	41.29	46.41
	Fixed carbon .....	44.10	42.87	47.68	53.59
	Ash .....	10.20	9.92	11.03	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.23	5.39	4.75	5.34
	Carbon .....	65.06	63.24	70.33	79.05
	Nitrogen .....	1.40	1.36	1.51	1.70
	Oxygen .....	14.54	16.62	8.52	9.57
	Sulphur .....	8.57	3.47	3.86	4.34
	Ash .....	10.20	9.92	11.03	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	6499	6318	7026	7897
	B. T. U. ....	11698	11372	12647	14215
Calorific Value Calculated From Ultimate Analysis		Calories ..	6328	.....	.....
		B. T. U. ....	11390	.....	.....

## WEBSTER COUNTY.

No. 161.

Laboratory number .....19,119  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Location in mine.....Face of room 64, off No. 5 west,  
 5,100 feet from entrance.  
 Coal .....No. 11  
 Date of sampling .....4-8-'14  
 Date of analysis .....4-24-'14  
 Depth below surface.....50 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Black Slate			
1. Coal streaked with sulphur .....	.....		10
2. Sulphur band .....	.....		½
3. Coal streaked with sulphur and mother coal...	2		6½
4. "Blue band" .....	.....		1½
5. Coal streaked with sulphur and mother coal...	2		.....
Total .....	5		6½
Floor—hard, smooth fire clay.			
Excluded from sample, No. 4.			

Air-dry Loss, 2.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.15	4.24	.....	.....
	Volatile matter ..	39.03	38.19	39.88	45.29
	Fixed carbon .....	47.13	46.13	48.17	54.71
	Ash .....	11.69	11.44	11.95	.....
		100.00	100.00	100.00	100.00
Sulphur		4.19	4.10	4.28	4.86
Calorific Value Determined	Calories .....	7104	6952	7260	8245
	B. T. U. ....	12787	12514	13068	14841

## WEBSTER COUNTY.

No. 162.

Laboratory number .....19,120  
 Operator .....West Kentucky Coal Company  
 Mine (slope).....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Location in mine.....Room 14, 6 west,  
 about 3,000 feet from entrance.  
 Coal .....No. 11  
 Date of sampling .....4-8-'14  
 Date of analysis .....4-24-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Limestone		Feet 15	Inches
Hard, Black Slate		4 to 5	
1. Coal			9¾
2. Sulphur band			¾
3. Coal streaked with mother coal	1		6½
4. Mother coal			1½
5. Coal streaked with sulphur			9¾
6. "Blue band"			2½
7. Coal			9½
8. Sulphur band			1
9. Coal			2½
10. Sulphur band			¾
11. Coal			1½
12. Sulphur band			1
13. Coal			3½
Total		5	1¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 6-8-10-12.			

Air-dry Loss, 2.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	2.20	4.95		
	Volatile matter	37.84	36.78	38.70	42.87
	Fixed carbon	50.44	49.02	51.57	57.13
	Ash	9.52	9.25	9.73	
		100.00	100.00	100.00	100.00
Sulphur		4.00	3.89	4.09	4.53
Calorific Value Determined	Calories	7286	7081	7450	8253
	B. T. U.	13115	12746	13410	14855

## WEBSTER COUNTY.

No. 163.

Laboratory number .....19,121  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Location in mine .....Along left rib of 5th west entry,  
 5,100 feet from entrance.  
 Coal .....No. 11  
 Date of sampling .....4-8-'14  
 Date of analysis .....4-24-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Limestone		Feet 15	Inches
Black Slate		4 to 5	
1. Coal			11
2. Sulphur band			¾
3. Coal streaked with sulphur and mother coal	2		6
4. "Blue band"			2
5. Coal			3½
6. Sulphur band			¾
7. Coal			7
8. Sulphur band			1
9. Coal			10½
Total		5	5¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 4-8.			

Air-dry Loss, 2.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	2.20	4.17		
	Volatile matter	39.28	38.49	40.16	44.20
	Fixed carbon	49.58	48.58	50.70	55.80
	Ash	3.94	3.76	9.14	
		100.00	100.00	100.00	100.00
Sulphur		3.88	3.80	3.97	4.37
Calorific Value Determined	Calories	7307	7160	7471	8223
	B. T. U.	13153	12888	13448	14801

## WEBSTER COUNTY.

No. 164.

Laboratory number .....19,122  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Location in mine .....Face of 4th west entry,  
 5,000 feet from entrance.  
 Coal .....No. 11  
 Date of sampling .....4-8-'14  
 Date of analysis .....4-25-'14  
 Depth below surface .....50 feet

## SECTION OF MINE.

Roof—Limestone	Feet	Inches
Draw Slate		
1. Coal .....		4½
2. Sulphur band .....		½
3. Coal with ¾ inch mother coal 3 inches from top	1	3
4. Mother coal .....		1
5. Coal streaked with mother coal .....	1	2
6. "Blue band" .....		2
7. Coal .....		3½
8. Knife edge sulphur band .....		
9. Coal .....		7
10. Sulphur .....		½
11. Coal streaked with sulphur.....	1	
Total .....	5	0
Floor—hard fire clay. Excluded from sample, Nos. 2-6-10.		

Air-dry Loss, 1.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.05	3.81		
	Volatile matter ..	38.50	37.81	39.31	44.04
	Fixed carbon .....	48.92	48.04	49.94	55.96
	Ash .....	10.53	10.34	10.75	
		100.00	100.00	100.00	100.00
Sulphur		4.06	3.99	4.15	4.65
Calorific Value Determined	Calories .....	7184	7055	7334	8217
	B. T. U. ....	12931	12699	13201	14791

## WEBSTER COUNTY.

No. 165.

Laboratory number .....19,123  
 Operator .....West Kentucky Coal Company  
 Mine (slope) .....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Location in mine .....Rib face of 6th east air course,  
 2,800 feet from entrance.  
 Coal .....No. 11  
 Date of sampling .....4-8-'14  
 Date of analysis .....4-25-'14  
 Depth below surface .....75 feet

## SECTION OF MINE.

Roof—Limestone	Feet 15	Inches
Black Slate		
1. Coal .....		7
2. Coal with two thin sulphur bands .....		1
3. Coal with mother coal bands .....	1	11
4. Thin sulphur .....		
5. Coal .....		6½
6. "Blue band" .....		2
7. Coal .....		2
8. Sulphur band .....		½
9. Coal .....		6½
10. Sulphur .....		¾
11. Coal .....		9½
Total .....	4	10¾
Floor—hard fire clay. Excluded from sample, Nos. 2-6-10.		

Air-dry Loss, 1.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.85	4.16		
	Volatile matter ..	37.95	37.44	39.06	43.72
	Fixed carbon .....	48.83	48.17	50.27	56.28
	Ash .....	10.37	10.23	10.67	
		100.00	100.00	100.00	100.00
Sulphur		4.07	4.02	4.19	4.69
Calorific Value Determined	Calories .....	7134	7038	7343	8220
	B. T. U. ....	12841	12668	13217	14796

## WEBSTER COUNTY.

No. 166.

Laboratory number .....19,124F  
 (Composite of Nos. 19,119-20-21-22-23.)  
 Operator .....West Kentucky Coal Company  
 Mine .....No. 4  
 Location .....1,000 feet west of Wheatcroft Station  
 Coal .....No. 11  
 Date of analysis .....4-25-'14

Air-dry Loss, 2.0		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.30	4.27	.....	.....
	Volatile matter ..	38.84	38.08	39.76	44.44
	Fixed carbon .....	48.56	47.58	49.70	55.56
	Ash .....	10.30	10.09	10.54	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.10	5.22	4.96	5.54
	Carbon .....	70.92	69.49	72.59	81.14
	Nitrogen .....	1.46	1.43	1.49	1.67
	Oxygen .....	8.15	9.78	6.25	6.99
	Sulphur .....	4.07	3.99	4.17	4.66
	Ash .....	10.30	10.09	10.54	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7186	7041	7355	8221
	B. T. U. ....	12935	12674	13239	14798
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	7083	.....	.....
	B. T. U. ....	.....	12749	.....	.....

## WEBSTER COUNTY.

No. 167.

Laboratory number .....19,141  
 Operator .....Providence Mining Co.  
 Mine (shaft) .....No. 3  
 Location ..... $\frac{1}{2}$  mile north of Providence  
 Location in mine.....Room 8, off 2nd east, off main north,  
 1,300 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-10-'14  
 Date of analysis .....4-28-'14

## SECTION OF MINE.

Roof--Black Slate		Feet	Inches
1. Coal .....			3½
2. Sulphur band .....			½
3. Coal .....	1		3
4. Sulphurous coal .....			¾
5. Coal with some sulphur .....	3		3
Total .....	4		10%
Floor—hard fire clay. Excluded from sample, none.			

Air-dry Loss, 2.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.75	5.60	.....	.....
	Volatile matter ..	38.30	37.18	39.38	44.00
	Fixed carbon .....	48.75	47.32	50.13	56.00
	Ash .....	10.20	9.90	10.49	.....
		100.00	100.00	100.00	100.00
Sulphur		4.45	4.32	4.58	5.12
Calorific Value Determined	Calories .....	7078	6871	7278	8131
	B. T. U. ....	12740	12368	13100	14636

## WEBSTER COUNTY.

No. 168.

Laboratory number .....19,142  
 Operator .....Providence Mining Co.  
 Mine (shaft) .....No. 3  
 Location ..... $\frac{3}{4}$  mile north of Providence  
 Location in mine.....Face of room 8, off 2nd west, off main north,  
 1,200 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-10-'14  
 Date of analysis .....5-7-'14

## SECTION OF MINE.

Roof—Black Slate		Feet	Inches
1. Coal .....			4½
2. Thin sulphur band .....			
3. Coal with vertical sulphur bands.....	1	3	
4. Sulphurous coal .....		1	
5. Coal .....	1	11½	
6. Sulphur lens .....		1	
7. Coal with thin sulphur streaks.....	1	½	
Total .....	4	9½	
Floor—hard fire clay.			
Excluded from sample, No. 6.			

Air-dry Loss, 3.1		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.10	6.10		
	Volatile matter ..	37.90	36.73	39.12	44.62
	Fixed carbon .....	47.05	45.59	48.55	55.38
	Ash .....	11.95	11.68	12.33	
		100.00	100.00	100.00	100.00
Sulphur		4.21	4.08	4.35	4.96
Calorific Value Determined	Calories .....	6853	6641	7073	8067
	B. T. U. ....	12335	11954	12731	14521

## WEBSTER COUNTY.

No. 169.

Laboratory number .....19,143  
 Operator .....Providence Mining Co.  
 Mine (shaft) .....No. 3  
 Location ..... $\frac{3}{4}$  mile north of Providence  
 Location in mine.....Face of room 14, 2nd west off main north entry,  
 1,450 feet from shaft.  
 Coal .....No. 9  
 Date of sampling .....4-10-'14  
 Date of analysis .....5-7-'14

## SECTION OF MINE.

Roof--Black Slate		Feet	Inches
1. Coal		1	
2. Coal with disseminated sulphur.			9½
3. Mother coal			½
4. Coal			4
5. Mother coal			½
6. Coal		2	6
Total		4	8½
Floor--hard fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture . . . . .	2.80	5.55		
	Volatile matter ..	39.05	37.94	40.17	44.01
	Fixed carbon .....	49.67	48.27	51.11	55.99
	Ash .....	8.48	8.24	8.72	
		100.00	100.00	100.00	100.00
Sulphur		2.80	2.72	2.88	3.16
Calorific Value Determined	Calories .....	7222	7018	7431	8141
	B. T. U. ....	13000	12638	13376	14654

## WEBSTER COUNTY.

No. 170.

Laboratory number .....19,144  
 Operator .....Providence Mining Co.  
 Mine (shaft) .....No. 3  
 Location ..... $\frac{1}{2}$  mile north of Providence  
 Location in mine. .... Face of room 6, off 3rd west, off main north,  
 1,500 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-10-'14  
 Date of analysis ..... 4-29-'14  
 Depth below surface .....175 feet

## SECTION OF MINE.

Roof—Hard Black Slate		Feet 2 to 7	Inches
1. Coal .....			3½
2. Thin sulphur band .....			
3. Coal with disseminated sulphur .....	3		4¼
4. Sulphur band .....			¼
5. Coal streaked with sulphur .....	1		
Total .....	4		8
Floor—hard, smooth fire clay. Excluded from sample, none.			

Air-dry Loss, 2.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.43	4.95		
	Volatile matter ..	38.22	37.23	39.17	44.47
	Fixed carbon ....	47.72	46.49	48.91	55.53
	Ash .....	11.63	11.33	11.92	
		100.00	100.00	100.00	100.00
Sulphur		5.75	5.60	5.89	6.69
Calorific Value Determined	Calories .....	6959	6779	7132	8097
	B. T. U. ....	12526	12202	12838	14575

## WEBSTER COUNTY.

No. 171.

Laboratory number .....19,145  
 Operator .....Providence Mining Co.  
 Mine (shaft) .....No. 3  
 Location ..... $\frac{1}{2}$  mile north of Providence  
 Location in mine. .... Last break-through, room 19, 1st W. off N. main,  
 1,500 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-10-'14  
 Date of analysis ..... 4-29-'14  
 Depth below surface .....150 feet

## SECTION OF MINE.

Roof—Black Slate		Feet 2 to 7	Inches
1. Coal .....		1	.....
2. Sulphur band mixed with coal.....			2
3. Coal mixed with sulphur.....		2	11½
4. Sulphur band .....			¼
5. Coal .....			6
Total .....		4	7¾
Floor—hard, smooth fire clay.			
Excluded from sample, none.			

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.10	5.51	.....	.....
	Volatile matter ..	37.45	36.52	38.65	43.52
	Fixed carbon .....	48.60	47.39	50.15	56.48
	Ash .....	10.85	10.58	11.20	.....
		100.00	100.00	100.00	100.00
Sulphur		3.65	3.56	3.77	4.25
Calorific Value Determined	Calories .....	6978	6804	7201	8109
	B. T. U. ....	12560	12247	12962	14596

## WEBSTER COUNTY.

No. 172.

Laboratory number .....19,146  
 Operator ..... Providence Mining Co.  
 Mine (shaft) ..... No. 3  
 Location .....  $\frac{3}{8}$  mile north of Providence  
 Location in mine. .... Face of main north entry,  
                                     1,500 feet from shaft.  
 Coal ..... No. 9  
 Date of sampling ..... 4-10-'14  
 Date of analysis ..... 5-7-'14  
 Depth below surface ..... 175 feet

## SECTION OF MINE.

Roof—Black Slate				Feet 2 to 7	Inches
1. Coal .....					6½
2. Sulphur band .....					¾
3. Coal .....					7½
4. Mother coal .....					¾
5. Coal with sulphur balls and mother coal.....				3	6½
Total .....				4	9
Floor—hard, smooth fire clay.					
Excluded from sample, No. 2.					

Air-dry Loss, 2.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.80	5.28		
	Volatile matter ..	38.95	37.96	40.07	43.86
	Fixed carbon .....	49.85	48.57	51.28	56.14
	Ash .....	8.40	8.19	8.65	
		100.00	100.00	100.00	100.00
Sulphur		3.43	3.34	3.35	3.86
Calorific Value Determined	Calories .....	7249	7064	7457	8163
	B. T. U. ....	13048	12715	13423	14693

## WEBSTER COUNTY.

No. 173.

Laboratory number .....19,147  
 (Composite of 19,141-42-43-44-45-46.)  
 Operator ..... Providence Mining Co.  
 Mine (shaft) ..... No. 3  
 Location .....  $\frac{3}{8}$  mile N. of Providence  
 Coal ..... No. 9  
 Date of analysis ..... 4-29-'14

Air-dry Loss, 2.8		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.95	5.62		
	Volatile matter ..	38.25	37.20	39.41	44.09
	Fixed carbon .....	48.51	47.17	49.98	55.91
	Ash .....	10.29	10.01	10.61	
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.06	5.23	4.88	5.46
	Carbon .....	70.02	68.09	72.14	80.70
	Nitrogen .....	1.47	1.43	1.52	1.70
	Oxygen .....	9.16	11.35	6.73	7.53
	Sulphur .....	4.00	3.89	4.12	4.61
	Ash .....	10.29	10.01	10.61	
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7044	6850	7258	8120
	B. T. U. ....	12680	12330	13064	14616
Calorific Value Calculated From Ultimate Analysis	Calories ..		6902		
	B. T. U. ....		12424		

## WEBSTER COUNTY.

No. 174.

Laboratory number .....19,148  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location .....1¼ miles N. W. of Clay  
 Location in mine .....Face of dip entry air course on west,  
 1,850 feet from shaft.  
 Coal .....Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-7-'14  
 Depth below surface .....235 feet

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches		
1. Coal left as roof.....		1	6		
2. Coal .....		2	10		
3. Coal streaked with sulphur.....			½		
4. Coal .....		2	7½		
Total .....		7	0		
Floor—hard fire clay. Excluded from sample, No. 1.					
Air-dry Loss, 2.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.94	5.73	.....	.....
	Volatile matter ..	37.21	36.14	38.34	41.66
	Fixed carbon .....	52.12	50.62	53.69	58.34
	Ash .....	7.73	7.51	7.97	.....
		100.00	100.00	100.00	100.00
Sulphur		2.06	2.00	2.12	2.30
Calorific Value Determined	Calories .....	7388	7176	7612	8271
	B. T. U. ....	13298	12916	13701	14887

## WEBSTER COUNTY.

No. 175.

Laboratory number .....19,149  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location .....1¼ miles N. W. of Clay  
 Location in mine .....Neck of break-through  
 between 3rd and 4th south, off 2nd right,  
 1,600 feet from shaft.

Coal .....Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-7-'14

## SECTION OF MINE.

Roof—Gray Shale		Feet	Inches
1. Coal left as roof .....		1	6
2. Coal .....		5	6
Total .....		7	0
Floor—hard, shaly fire clay. Excluded from sample, No. 1.			

Air-dry Loss, 2.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.90	5.24	.....	.....
	Volatile matter ..	37.05	36.16	38.16	40.94
	Fixed carbon .....	53.46	52.17	55.05	59.06
	Ash .....	6.59	6.43	6.79	.....
		100.00	100.00	100.00	100.00
Sulphur		1.33	1.30	1.37	1.47

Calorific Value Determined	Calories .....	7458	7278	7680	8239
	B. T. U. ....	13424	13100	13824	14830

## WEBSTER COUNTY.

No. 176.

Laboratory number .....19,150  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location .....1¼ miles N. W. of Clay  
 Location in mine.....Face of 4th south, off 2nd left entry,  
 2,800 feet from shaft.  
 Coal .....Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-7-'14  
 Depth below surface.....235 feet

## SECTION OF MINE.

Roof—Shaly Fire Clay		Feet 1 to 2	Inches		
1. Coal left as roof.....		1	.....		
2. Coal with spider-web sulphur.....		6	2		
Total .....		7	2		
Floor—hard fire clay.					
Excluded from sample, No. 1.					
Air-dry Loss, 3.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.09	6.38	.....	.....
	Volatile matter ..	35.71	34.60	36.85	41.18
	Fixed carbon .....	51.00	49.27	52.63	58.82
	Ash .....	10.20	9.85	10.52	.....
		100.00	100.00	100.00	100.00
Sulphur		1.13	1.09	1.16	1.30
Calorific Value Determined	Calories .....	7091	6849	7315	8175
	B. T. U. ....	12764	12328	13167	14715

## WEBSTER COUNTY.

No. 177.

Laboratory number .....19,151  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location .....1¼ miles N. W. of Clay  
 Location in mine.....Face of room 10, off 1st left, off west dip entry,  
 2,000 feet from shaft.  
 Coal .....Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-7-'14  
 Depth below surface .....235 feet

## SECTION OF MINE.

Roof—Gray shale With Ferns		Feet	Inches		
1. Top coal left as roof.....			6		
2. Coal .....		1	4¼		
3. Mother coal .....			½		
4. Coal .....			9		
5. Sulphur band .....			¾		
6. Coal .....		3	0½		
7. Bottom coal .....			6		
Total .....		6	2½		
Floor—hard, smooth, shaly fire clay. Excluded from sample, Nos. 1-7.					
Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.27	5.65	.....	.....
	Volatile matter ..	36.26	35.37	37.49	40.47
	Fixed carbon .....	53.35	52.04	55.15	59.53
	Ash .....	7.12	6.94	7.36	.....
		100.00	100.00	100.00	100.00
Sulphur		1.20	1.17	1.24	1.34
Calorific Value Determined	Calories .....	7386	7204	7636	8242
	B. T. U. ....	13295	12967	13745	14836

## WEBSTER COUNTY.

No. 178.

Laboratory number .....19,152  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location .....1¼ miles N. W. of Clay  
 Location in mine.....Face of room 14, 1st south entry, off 2nd right entry,  
 1,600 feet from shaft.  
 Coal ..... Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-7-'14  
 Depth below surface .....235 feet

## SECTION OF MINE.

Gray Shale With Ferns		Feet	Inches
1. Immediate roof coal .....		1	6
2. Coal .....			7½
3. Soft sulphur band .....			¼
4. Coal .....	2	8½	
5. Mother coal .....			½
6. Coal .....			2½
7. Mother coal .....		2	
8. Coal streaked with sulphur and mother coal....	1	9½	
9. Bottom coal .....			6
Total .....		7	6¾
Floor—hard, shaly fire clay.			
Excluded from section, Nos. 1-3-9.			

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	2.71	5.09		
	Volatile matter ..	37.09	36.18	38.12	41.91
	Fixed carbon .....	51.39	50.14	52.83	58.09
	Ash .....	8.81	8.59	9.05	
		100.00	100.00	100.00	100.00
Sulphur		2.85	2.78	2.93	3.22
Calorific Value Determined	Calories .....	7272	7094	7474	8218
	B. T. U. ....	13089	12769	13453	14793

## WEBSTER COUNTY.

No. 179.

Laboratory number .....19,153  
 Operator.....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Location.....1¼ miles N. W. of Clay  
 Location in mine.....Last break-through, face 2nd west left entry,  
 3,000 feet from shaft.  
 Coal ..... Baker (Local, No. 12.)  
 Date of sampling .....4-9-'14  
 Date of analysis .....5-8-'14  
 Depth below surface .....235 feet

## SECTION OF MINE.

Roof—Gray Shale With Ferns		Feet	Inches
1. Top coal left as roof.....		1	
2. Coal .....		1	½
3. Mother coal .....			¾
4. Coal streaked with mother coal.....		4	10
5. Bottom coal .....			6
Total .....		7	4¾
Floor—hard, smooth, shaly fire clay. Excluded from sample, Nos. 1-5.			

Air-dry Loss, 2.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.53	5.80		
	Volatile matter ..	34.22	33.42	35.48	39.11
	Fixed carbon .....	53.30	52.04	55.24	60.89
	Ash .....	8.95	8.74	9.28	
		100.00	100.00	100.00	100.00
Sulphur		1.16	1.13	1.20	1.32
Calorific Value Determined	Calories .....	7168	7000	7431	8191
	B. T. U. ....	12902	12600	13376	14744

## WEBSTER COUNTY.

No. 180.

Laboratory number .....19,154F  
 (Composite of 19,148-49-50-51-52-53.)  
 Operator .....West Kentucky Coal Co.  
 Mine (shaft) .....No. 7  
 Coal .....Baker (Local No. 12.)  
 Location .....1¼ miles N. W. of Clay  
 Date of analysis .....5-8-'14

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.00	5.58	.....	.....
	Volatile matter ..	36.00	35.04	37.11	40.58
	Fixed carbon .....	52.72	51.32	54.35	59.42
	Ash .....	8.28	8.06	8.54	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.16	5.32	4.98	5.45
	Carbon .....	73.44	71.49	75.72	82.79
	Nitrogen .....	1.54	1.50	1.59	1.74
	Oxygen .....	9.95	12.04	7.49	8.18
	Sulphur .....	1.63	1.59	1.68	1.84
	Ash .....	8.28	8.06	8.54	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7280	7086	7505	8206
	B. T. U. ....	13104	12755	13509	14771
Calorific Value Calculated From Ultimate Analysis	Calories .....		7125	.....	.....
	B. T. U. ....		12825	.....	.....

## WEBSTER COUNTY.

No. 181.

Laboratory number .....19,176  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine..... Face of room 45, off N. W. entry,  
 2,700 feet from shaft.

Coal ..... No. 11  
 Date of sampling .....4-14-'14  
 Date of analysis .....5-20-'14  
 Depth below surface .....125 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 10	Inches
Black Slate			12
1.	Top coal adhering to roof .....		5
2.	Coal .....		10
3.	Sulphur band .....		$\frac{1}{8}$
4.	Coal .....		$7\frac{1}{2}$
5.	Mother coal .....		$\frac{1}{2}$
6.	Coal .....	1	9
7.	Thin sulphur .....		
8.	Coal .....		3
9.	"Blue band" .....		2
10.	Coal .....		2
11.	Thin sulphur band .....		
12.	Coal .....		8
13.	Sulphur .....		$\frac{1}{8}$
14.	Coal with sulphur .....	1	$\frac{1}{2}$
Total .....		5	$11\frac{1}{2}$
Floor—hard, rough fire clay. Excluded from sample, Nos. 1-9.			

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.35	5.94		
	Volatile matter ..	38.35	37.32	39.68	44.37
	Fixed carbon .....	48.10	46.81	49.76	55.63
	Ash .....	10.20	9.93	10.56	
		100.00	100.00	100.00	100.00
Sulphur		3.94	3.83	4.07	4.55
Calorific Value Determined	Calories .....	6944	6758	7185	8035
	B. T. U. ....	12499	12164	12933	14461

## WEBSTER COUNTY.

No. 182.

Laboratory number ..... 19,177  
 Operator ..... St. Bernard Mining Co.  
 Mine (shaft) ..... Shamrock  
 Location ..... 1½ miles N. E. of Providence  
 Location in mine ..... Face of room 8, off 5th west entry,  
 2,000 feet from shaft.  
 Coal ..... No. 11  
 Date of sampling ..... 4-13-'14  
 Date of analysis ..... 5-19-'14  
 Depth below surface ..... 210 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 10	Inches		
Black Slate			6		
1. Coal adhering to roof .....			2		
2. Shop coal .....	1				
3. Sulphur band .....			¾		
4. Coal .....			5½		
5. Sulphur band .....					
6. Coal .....	1		10		
7. Hard sulphur band .....			½		
8. Coal .....			4½		
9. "Blue band" .....			2		
10. Coal .....			2½		
11. Thin sulphur band .....					
12. Coal with thin sulphur .....	1		8		
Total .....	5		11¾		
Floor—rough, hard fire clay. Excluded from sample, Nos. 1-3-9.					
Air-dry Loss, 2.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.45	5.71		
	Volatile matter ..	39.50	38.58	40.92	44.64
	Fixed carbon .....	49.00	47.85	50.74	55.36
	Ash .....	8.05	7.86	8.34	
		100.00	100.00	100.00	100.00
Sulphur		3.67	3.53	3.80	4.15
Calorific Value Determined	Calories .....	7174	7006	7431	8107
	B. T. U. ....	12913	12611	13376	14593

## WEBSTER COUNTY.

No. 183.

Laboratory number ..... 19,178  
 Operator ..... St. Bernard Mining Co.  
 Mine (shaft) ..... Shamrock  
 Location ..... 1½ miles N. E. of Providence  
 Location in mine ..... Rib face of room 24, off 4th S. E. entry,  
 3,000 feet from shaft.  
 Coal ..... No. 11  
 Date of sampling ..... 4-14-'14  
 Date of analysis ..... 5-20-'14  
 Depth below surface ..... 70 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 10	Inches
Gray Shale			6
1. Coal		1	2
2. Sulphur band			¼
3. Coal		2	3½
4. Thin sulphur band			
5. Coal			3
6. "Blue band"			1½
7. Coal			2½
8. Thin sulphur band			
9. Coal		1	9½
Total		5	10¼
Floor—hard fire clay.			
Excluded from sample, No. 6.			

Air-dry Loss, 2.4		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.35	5.71		
	Volatile matter	39.55	38.58	40.92	45.81
	Fixed carbon	46.79	45.65	48.41	54.19
	Ash	10.31	10.06	10.67	
		100.00	100.00	100.00	100.00
Sulphur		4.06	3.96	4.20	4.70
Calorific Value Determined	Calories	6912	6743	7152	8006
	B. T. U.	12442	12137	12874	14411

## WEBSTER COUNTY.

No. 184.

Laboratory number .....19,179  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine.....Face of room 29, off 3rd N. W. entry,  
 2,600 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-13-'14  
 Date of analysis .....5-20-'14

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Black Slate			
1. Coal			10½
2. Sulphur			¾
3. Coal			3
4. Thin mother coal and sulphur			
5. Coal			10½
6. Mother coal			¾
7. Coal			9½
8. Sulphur lens			¾
9. Coal with mother coal near center			8
10. "Blue band"			1½
11. Coal			10½
12. Sulphur band			½
13. Coal			3½
14. Thin sulphur band			
15. Coal			10½
Total		5	9¾
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 2-8-10.			

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.00	5.63		
	Volatile matter	39.80	38.72	41.03	45.09
	Fixed carbon	48.47	47.16	49.97	54.91
	Ash	8.73	8.49	9.00	
		100.00	100.00	100.00	100.00
Sulphur		3.82	3.72	3.94	4.33
Calorific Value Determined	Calories	7140	6947	7362	8090
	B. T. U.	12852	12505	13252	14562

## WEBSTER COUNTY.

No. 185.

Laboratory number .....19,180  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine.....Rib face of 7th N. E. entry,  
 2,000 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-13-'14  
 Date of analysis .....5-20-'14  
 Depth below surface .....230 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 10	Inches
Black Slate			
1. Coal		1	1
2. Sulphur band			¾
3. Coal		1	9
4. Mother coal			1
5. Coal			10
6. "Blue band"			1½
7. Coal			2½
8. Thin sulphur band			
9. Coal with disseminated sulphur		1	9½
Total		5	11¾
Floor—hard fire clay.			
Excluded from sample, Nos. 2-6.			

Air-dry Loss, 2.3		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.50	5.75		
	Volatile matter	39.40	38.48	40.83	44.89
	Fixed carbon	48.37	47.24	50.12	55.11
	Ash	8.73	8.53	9.05	
		100.00	100.00	100.00	100.00
Sulphur		3.64	3.56	3.78	4.16
Calorific Value Determined	Calories	7076	6911	7333	8063
	B. T. U.	12737	12440	13199	14513

## WEBSTER COUNTY.

No. 186.

Laboratory number .....19,181  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine.....Face of room 46, off 1st S. E. entry,  
 3,500 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-14-'14  
 Date of analysis .....5-20-'14  
 Depth below surface .....80 feet

## SECTION OF MINE.

Roof—Limestone		Feet 3 to 10	Inches
Gray, Fossiliferous Shale		1	
1. Coal		1	8
2. Clay band			¾
3. Coal		1	11½
4. Sulphur band			½
5. Coal			8
6. "Blue band"			3½
7. Coal			2
8. Thin sulphur band			
9. Coal			11½
10. Thin sulphur band			
11. Coal			9½
Total		6	2
Floor—hard fire clay.			
Excluded from sample, Nos. 2-6.			

Air-dry Loss, 2.6		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.00	5.49		
	Volatile matter	39.80	38.78	41.03	45.24
	Fixed carbon	48.17	46.93	49.66	54.76
	Ash	9.03	8.80	9.31	
		100.00	100.00	100.00	100.00
Sulphur		4.04	3.94	4.17	4.60
Calorific Value Determined	Calories	7058	6877	7277	8024
	B. T. U.	12704	12379	13099	14443

## WEBSTER COUNTY.

No. 187.

Laboratory number .....19,182  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1¼ miles N. E. of Providence  
 Location in mine.....Last break-through, 1st N. E. entry,  
 2,100 feet from shaft.

Coal .....No. 11  
 Date of sampling .....4-14-'14  
 Date of analysis .....5-16-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Limestone		Feet	Inches
Hard, Black Slate			
1. Coal		1	½
2. Sulphur band			½
3. Coal streaked with mother coal		2	4
4. Sulphur band			½
5. Coal			3
6. "Blue band"			1½
7. Coal streaked with sulphur		2	
Total		5	10½
Floor—hard, smooth fire clay.			
Excluded from sample, Nos. 2-4-6.			

Air-dry Loss, 3.2		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.60	6.67		
	Volatile matter	38.15	36.94	39.58	43.99
	Fixed carbon	48.53	47.03	50.39	56.01
	Ash	9.67	9.36	10.03	
		100.00	100.00	100.00	100.00
Sulphur		4.58	4.43	4.75	5.28
Calorific Value Determined	Calories	6975	6753	7236	8043
	B. T. U.	12556	12155	13025	14477

## WEBSTER COUNTY.

No. 188.

Laboratory number .....19,183  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine.....Face of 5th N. E. entry,  
 2,400 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-14-'14  
 Date of analysis .....5-20-'14

## SECTION OF MINE.

Roof—Limestone	Feet 3 to 10	Inches
Hard, Black Slate		2 to 24
1. Coal	1	2
2. Sulphur band		¾
3. Coal		10¾
4. Mother coal		½
5. Coal streaked with mother coal	1	7½
6. "Blue band"		1½
7. Coal streaked with sulphur		10½
8. Sulphur band		¾
9. Coal mixed with sulphur ball	1	1
Total	5	10¾
Floor—hard, smooth fire clay, 10 feet. Excluded from sample, No. 6.		

Air-dry Loss, 2.5		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.20	5.59		
	Volatile matter	37.95	37.01	39.20	44.14
	Fixed carbon	48.02	46.84	49.61	55.86
	Ash	10.83	10.56	11.19	
		100.00	100.00	100.00	100.00
Sulphur		4.98	4.86	5.15	5.80
Calorific Value Determined	Calories	6916	6745	7144	8044
	B. T. U.	12449	12141	12859	14479

## WEBSTER COUNTY.

No. 189.

Laboratory number .....19,184  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Location in mine.....Face of 3rd northeast,  
 2,400 feet from shaft.  
 Coal .....No. 11  
 Date of sampling .....4-14-'14  
 Date of analysis .....5-16-'14  
 Depth below surface .....100 feet

## SECTION OF MINE.

Roof—Limestone	Feet	Inches
Hard, Black Slate		
1. Coal adhering to roof		2
2. Coal streaked with mother coal	1	½
3. Sulphur band		¾
4. Coal streaked with mother coal	2	½
5. Sulphur band		8¼
6. Coal streaked with sulphur		1¾
7. "Blue band"	2	1
8. Coal streaked with sulphur		2¾
Total	6	
Floor—hard, smooth fire clay. Excluded from sample, Nos. 1-3-5-7.		

Air-dry Loss, 3.9		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture	3.75	7.48		
	Volatile matter	38.45	36.96	39.95	44.27
	Fixed carbon	48.41	46.53	50.29	55.73
	Ash	9.39	9.03	9.76	
		100.00	100.00	100.00	100.00
Sulphur		4.14	3.98	4.30	4.77
Calorific Value Determined	Calories	7011	6739	7284	8072
	B. T. U.	12620	12130	13111	14530

## WEBSTER COUNTY.

No. 190.

Laboratory number .....19,185  
 (Composite of 19,176-77-78-79-80-81-82-83-84.)  
 Operator .....St. Bernard Mining Co.  
 Mine (shaft) .....Shamrock  
 Location .....1½ miles N. E. of Providence  
 Coal .....No. 11  
 Date of analysis .....5-20-14

Air-dry Loss, 2.7		Coal Air Dried	Coal as Received	Coal Moisture Free	Coal Moisture and Ash Free
Proximate Analysis	Moisture .....	3.36	6.00	.....	.....
	Volatile matter ..	38.94	37.88	40.30	44.73
	Fixed carbon .....	48.12	46.80	49.79	55.27
	Ash .....	9.58	9.32	9.91	.....
		100.00	100.00	100.00	100.00
Ultimate Analysis	Hydrogen .....	5.10	5.26	4.88	5.42
	Carbon .....	70.12	68.21	72.56	80.54
	Nitrogen .....	1.35	1.81	1.39	1.54
	Oxygen .....	9.75	11.91	7.02	7.79
	Sulphur .....	4.10	3.99	4.24	4.71
	Ash .....	9.58	9.32	9.91	.....
		100.00	100.00	100.00	100.00
Calorific Value Determined	Calories .....	7019	6827	7263	8062
	B. T. U. ....	12634	12289	13073	14512
Calorific Value Calculated From Ultimate Analysis	Calories .....	.....	6900	.....	.....
	B. T. U. ....	.....	12420	.....	.....